

# **PART 70 SIGNIFICANT SOURCE MODIFICATION OFFICE OF AIR QUALITY**

**Eli Lilly and Company - Tippecanoe Laboratories  
1650 Lilly Road  
Lafayette, Indiana 47909**

(herein known as the Permittee) is hereby authorized to construct and operate subject to the conditions contained herein, the emission units described in Section A (Source Summary) of this approval.

This approval is issued in accordance with 326 IAC 2 and 40 CFR Part 70 Appendix A and contains the conditions and provisions specified in 326 IAC 2-7 as required by 42 U.S.C. 7401, et. seq. (Clean Air Act as amended by the 1990 Clean Air Act Amendments), 40 CFR Part 70.6, IC 13-15 and IC 13-17.

Source Modification No.:157-14897-00006	
Issued by: Original signed by Paul Dubenetz0ky Paul Dubenetzky, Branch Chief Office of Air Quality	Issuance Date: December 26, 2001

## Indiana Department of Environmental Management Office of Air Quality

### Technical Support Document (TSD) for a Significant Source Modification

#### Source Background and Description

Source Name:	Eli Lilly and Company, Tippecanoe Laboratories	
Source Location:	1650 Lilly Road, Lafayette, Indiana 47909	
County:	Tippecanoe	
SIC Code:	2834 & 2879	
Operation Permit No.:	TV157-6879-00006	Issuance Date: Pending
Significant Source Modification No.:	157-14897-00006	
Permit Reviewer:	Aida De Guzman	

The Office of Air Quality (OAQ) has reviewed an application from Eli Lilly and Company relating to the construction and operation of the following process tanks to be used in a variety of operations involved in pharmaceutical manufacturing:

- (a) New Process Tanks:
  - (1) One (1) General Process Tank, identified as TK20 to be installed in building T100 with a capacity of 4,000 gallons;
  - (2) One (1) Mother Liquor Receiver Tank, identified as TK-HF3 to be installed in building T28 with a capacity of 100 gallons;
  - (3) One (1) Centrifuge HF-3, to be installed in building T28; and
  - (4) Miscellaneous piping loop that will connect production buildings T28 and T100 with the existing solvent storage in building T146.
- (b) Replacement Tanks:
  - (1) One (1) General Process Tank, identified as TK7 to be installed in building T28 with a capacity of 2,000 gallons. The existing Tank TK7 is a 2,000 gallon stainless steel tank that will be replaced by a 2,000 gallon hastelloy tank.
  - (2) One (1) General Process Tank, identified as TK18 to be installed in building T28 with a capacity of 500 gallons. The existing Tank TK18 is a 750 gallon glass lined tank that will be replaced by a 500 gallon glass lined tank; and
  - (3) One (1) General Process Tank, identified as TK26 to be installed in building T100 with a capacity of 4,000 gallons. The existing Tank TK26 is a 4,000 gallon stainless steel tank that will be replaced by a 4,000 gallon hastelloy tank.

The point source emissions from the new and replacement process vessels may vent directly to the RTOs, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessels to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device that complies with 326 IAC 8-5-3. The sulfur dioxide and nitrogen oxides emissions from these tanks are voluntarily controlled by caustic scrubbers.

## History

The source has submitted a Title V permit (TV 157-6879-00006) on October 10, 1996, and it is still pending for issuance.

## Recommendation

The staff recommends to the Commissioner that the Significant Source Modification be approved. This recommendation is based on the following facts and conditions:

Unless otherwise stated, information used in this review was derived from the application and additional information submitted by the applicant.

An application for the purposes of this review was received on September 11, 2001, with additional information received on October 3, 2001.

## Emission Calculations

- (a) Process Tanks Emissions: See Appendix A, Emission Calculations submitted by the source.

## Potential To Emit

Pursuant to 326 IAC 2-1.1-1(16), Potential to Emit is defined as “the maximum capacity of a stationary source or emissions unit to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or type or amount of material combusted, stored, or processed shall be treated as part of its design if the limitation is enforceable by the U. S. EPA, the department, or the appropriate local air pollution control agency”.

Pollutant	Potential To Emit (tons/year)
PM	0.00
PM-10	0.00
SO <sub>2</sub>	196.95
VOC	229.49
CO	207.62
NO <sub>x</sub>	17.80

Note: For the purpose of determining Title V applicability for particulates, PM-10, not PM, is the regulated pollutant in consideration.

HAPs	Potential To Emit (tons/year)
Inorganic HAPs Combined	151.19
Organic HAPs Combined	229.49
TOTAL HAPs	380.68

## Justification for the Permit Level

General Tank TK7, General Tank TK18 and General Tank TK 26 are replacement process tanks (see justification on page 6 of 9, 1<sup>st</sup> paragraph of this TSD). These tanks are subject to 326 IAC 2-7-10.5(d) Minor Source Modification because no increase in the actual emissions will result since the tanks capacities are the same as the replaced tanks and no change in the process operation will occur. However, this application includes new process tanks General Tank TK 20, Centrifuge HF-3, Mother Liquor Receiver Tank TK HF-3 and Miscellaneous Piping modification which will have an uncontrolled PTE of VOC greater than 25 tons per year. Therefore 326 IAC 2-7-10.5(f), Significant Source Modification will apply.

## Actual Emissions

The following table shows the actual emissions from the source. This information reflects the 1999 OAQ emission data.

Pollutant	Actual Emissions (tons/year)
PM	0.00
PM-10	408.00
SO <sub>2</sub>	1,574
VOC	142.00
CO	188.00
NO <sub>x</sub>	401.00

## Source Status

Existing Source PSD, Part 70 or FESOP Definition (emissions after controls, based upon AIRS Facility Quick Look Report, updated January 22, 1999).

Pollutant	Emissions (ton/yr)
PM	682.1
PM10	682.1
SO <sub>2</sub>	5,626
VOC	5,351
CO	363
NO <sub>x</sub>	2,834

- (a) This existing source is a major stationary source because an attainment regulated pollutant is emitted at a rate of 100 tons per year or more, and it is one of the 28 listed source categories.

## Limited/Controlled Potential to Emit

The table below summarizes the total potential to emit, reflecting all limits, of the significant emission units.

Process/Facility	Capacity (gallons)	Limited/Controlled Potential to Emit				
		VOC	CO	SO <sub>2</sub>	NO <sub>x</sub>	Total HAPs
General Tank TK 20	4,000	6.62	79.09		6.78	54.62
	Fugitive	4.70				4.70
General Tank TK 26	4,000	6.62 *	79.09 *	121.20 *	6.78 *	54.62 *
	Fugitive	0.11 *				0.11 *
General Tank TK 7	2,000	3.90 *	39.55 *	60.60 *	3.39 *	27.90 *
	Fugitive	2.20 *				2.20 *
General Tank TK 18	500	1.07 *	9.89 *	15.15 *	0.85 *	7.07 *
	Fugitive	1.91 *				1.91 *
Centrifuge HF-3	N/A	3.20				27.20
	Fugitive	0.37				0.37

Mother Liquor Receiver Tank TK HF-3	100	0.83				2.02
	Fugitive	4.11				4.11
Miscellaneous Piping Modification	Fugitive	2.65				2.65
TOTAL Controlled Emissions		38.28	207.62	196.95	17.80	189.47
TOTAL PSD Applicability Emissions		22.48	79.09	0.00	6.78	0.00
PSD Significant Levels		40	100	40	40	N/A

**Note:** Tank Total HAPs = tank controlled inorganic emissions + tank controlled organic emissions + fugitive emissions  
Emissions from the replacement tanks which are marked by asterisk (\*) were not counted towards PSD applicability.

- (a) Fugitive emissions are subject to 326 IAC 2-2 or are counted towards Prevention of Significant Deterioration (PSD), since the source is in one of the twenty-eight (28) listed sources, which is a Chemical Process Plant.
- (b) General Tanks TK7, TK18, and TK26 are replacement of the old process tanks, which qualify as routine maintenance, repair, and replacement under the PSD rules (40 CFR 52.21) and 326 IAC 2-2, and are exempt from the PSD permitting requirements.
- (c) General Tanks TK20, Centrifuge HF-3, Mother Liquor Receiver Tank TK HF-3 and the Miscellaneous Piping Modification are not subject to 326 IAC 2-2, because no criteria pollutant is emitted at a significant level of 40 tons per year, and CO is not emitted at a rate of 100 tons per year.

### County Attainment Status

The source is located in Tippecanoe County.

Pollutant	Status
PM-10	attainment
SO <sub>2</sub>	attainment
NO <sub>2</sub>	attainment
Ozone	attainment
CO	attainment
Lead	attainment

- (a) Volatile organic compounds (VOC) and oxides of nitrogen (NO<sub>x</sub>) are precursors for the formation of ozone. Therefore, VOC and NO<sub>x</sub> emissions are considered when evaluating the rule applicability relating to the ozone standards. Tippecanoe County has been designated as attainment or unclassifiable for ozone.
- (b) Tippecanoe County has been classified as attainment or unclassifiable for all the other criteria pollutants. Therefore, these emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2 and 40 CFR 52.21.

### Federal Rule Applicability

- (a) New Source Performance Standards (NSPS):
  - (1) 326 IAC 12, 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for which construction, reconstruction, or modification commenced after July 23, 1994. This NSPS is not applicable to the new tanks, because they are process tanks and not storage tanks.
  - (2) 326 IAC 12, 40 CFR Part 60, Subpart VV - Standards of Performance for

Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

- (3) 40 CFR § 60.610, Subpart III - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes -

The tanks are not subject to this NSPS because they are not air oxidation units.

- (4) 40 CFR § 60.660, Subpart NNN - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations.

The tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

- (5) 40 CFR § 60.700, Subpart RRR - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes.

The tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

- (6) There are no other New Source Performance Standards (NSPS)(326 IAC 12 and 40 CFR Part 60) applicable to this source.

(b) National Emission Standards for Hazardous Air Pollutants (NESHAPs):

- (1) 40 CFR Part 63, Subparts I and H - National Emission Standards for Organic Hazardous Air Pollutants for Certain Processes Subject to the Negotiated Regulation for Equipment Leaks; and 40 CFR Part 63, Subpart H - National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks.

The tanks are subject to this NSPS, Subpart I and H when Methylene Chloride is used in them for pharmaceutical synthesis operations. Eli Lilly will comply with these requirements, with the implementation of Eli Lilly's LDAR program, when Methylene Chloride is used in the tanks.

- (2) 40 CFR Part 63, Subpart GGG - National Emission Standards for Hazardous Air Pollutants for Pharmaceutical Production which was promulgated on September 21, 1998. This NSPS applies to a new a source for which construction or reconstruction commenced after April 12, 1997 and the standard is applicable at the time of construction or reconstruction; or a pharmaceutical manufacturing process unit (PMPU) dedicated to manufacture a single product that has the potential to emit 10 tons per year of any one HAP or 25 tons per year of combined HAPs for which construction commenced after April 12, 1997 or reconstruction commenced after October 21, 1999.

The construction of the new process tanks, General Tank TK7; General Tank TK18, General Tank TK20, General Tank 26, Centrifuge HF-3; Mother Liquor Receiver Tank TK HF-3 does not constitute a construction or reconstruction of a pharmaceutical manufacturing process unit (PMPU) nor does constitute a construction or reconstruction of an affected facility. Therefore, these tanks will be subject to the standards of Subpart GGG for existing affected source, and be in compliance no later than the compliance date, October 21, 2002.

### State Rule Applicability - Entire Source

- (a) 326 IAC 2-2 (Prevention of Significant Deterioration) and 40 CFR Part 52.21  
In Minor Source Modification 157-11949-00006, issued on May 3, 2000, replacements tanks for Lilly were determined to qualify as routine maintenance, repair, and replacement and were not subject to 326 IAC 2-2, and 40 CFR Part 52.21 because of the following:
- (1) Nature and extent - Replacement of a pharmaceutical process tank with a like-kind tank does not involve the replacement of numerous major components of the production site;
  - (2) Purpose - Tank replacements do not significantly enhance the present efficiency and capacity of the plant. Tank replacement projects do not substantially extend the useful economic life of a pharmaceutical plant;
  - (3) Frequency - Tank replacements within a production building occur relatively frequently instead of only once or twice within a building's useful life;
  - (4) Cost - A tank replacement is not unusually costly, given the cost of manufacturing equipment. The cost of a new replacement tank is only a small fraction of the cost for an entirely new production building.
- (b) 326 IAC 2-6 (Emission Reporting)  
This source is subject to 326 IAC 2-6 (Emission Reporting), because it is a Title V source, which has the potential to emit more than one hundred (100) tons per year of at least one of the criteria pollutants. Pursuant to this rule, the owner/operator of the source must annually submit an emission statement for the source. The annual statement must be received by July 1 of each year and contain the minimum requirement as specified in 326 IAC 2-6-4. The submittal should cover the period defined in 326 IAC 2-6-2(8)(Emission Statement Operating Year).
- (c) 326 IAC 5-1 (Visible Emissions Limitations)  
Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Exemptions), opacity shall meet the following, unless otherwise stated in this permit:
- (1) Opacity shall not exceed an average of forty percent (40%) any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.
  - (2) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings) as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor in a six (6) hour period.

### State Rule Applicability - Individual Facilities

- (a) 326 IAC 8-5-3 (Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing Operations)
- (1) 326 IAC 8-5-3 applies to the manufacture of pharmaceutical products by chemical synthesis. This section applies to the proposed General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, Mother Liquor Receiver Tank TK HF-3 since each has the potential to emit 15 pounds per day or more. The sections that are applicable to Lilly are (b)(1), (5) and (6).

Section (b)(1) of this rule requires that the VOC emissions coming from these process tanks or reactors, and centrifuges, shall be controlled by condensers or equivalent controls. The approximate control efficiency required by 326 IAC 8-5-

3(b)(1) when using acetone, which has the worst volatility is around 90%.

- (A) Pursuant to 326 IAC 8-5-3(b)(1) the outlet gas temperature when using condensers to control the VOC emissions from the process tanks and the centrifuge shall not exceed the following:
  - (i) minus twenty-five degrees Celsius (-25°C) when condensing VOC of vapor pressure greater than forty (40) kilo Pascals (five and eight-tenths (5.8) pounds per square inch);
  - (ii) minus fifteen degrees Celsius (-15°C) when condensing VOC of vapor pressure greater than twenty (20) kilo Pascals (two and nine-tenths (2.9) pounds per square inch);
  - (iii) zero degrees Celsius (0°C) when condensing VOC of vapor pressure greater than ten (10) kiloPascals (one and five-tenths (1.5) pounds per square inch);
  - (iv) ten degrees Celsius (10°C) when condensing VOC of vapor pressure greater than seven (7) kiloPascals (one (1) pound per square inch); or
  - (v) twenty-five degrees Celsius (25°C) when condensing VOC of vapor pressure greater than three and five-tenths (3.5) kilo Pascals (five-tenths (0.5) pound per square inch).
- (B) The vapor pressures listed above shall be measured at twenty degrees Celsius (20°C).
- (C) If the equivalent controls are used, the VOC emissions must be reduced by at least as much as they would be by using a surface condenser which meets the requirements of clause (A).

Lilly is in compliance with this section of the rule, controlling the VOC emissions using either condensers in series with the Regenerative Thermal Oxidizer (RTO), or using the RTO alone. Lilly typically uses the existing RTO to control point source VOC emission from the tanks. The RTO, which has been demonstrated to achieve VOC removal efficiency in excess of 95%, will meet and exceed the requirement of the rule. If the RTO cannot be used due to safety issues, an alternative control device may be used. An analysis to demonstrate the alternative controls are equivalent controls will be done before they are used. Lilly would like to continue manufacturing operations in the process vessels included in this application using other existing pollution control equipment that complies with 326 IAC 8-5-3.

- (2) 326 IAC 8-5-3(b)(5) requires the owner or operator to install covers on all in process tanks that contain VOC's. Lilly complies with this section by using covers on all in process tanks, these covers are closed unless production sampling, maintenance, or inspection procedures require operator access.
- (3) 326 IAC 8-5-3(b)(6) requires the owner or operator to repair all visible leaks containing VOC. The repair shall be completed the first time the equipment is off line for a period of time long enough to complete the repair.
- (b) 326 IAC 8-1-6 (General Reduction Requirements)  
This rule is not applicable because the process tanks and the centrifuge are subject to 326 IAC 8-5-3.
- (c) 326 IAC 8 (Volatile Organic Sources)  
There are no other rule in Article 8 that would apply to the proposed process tanks.

- (d) 326 IAC 7 (Sulfur Dioxide Emission Limitation)  
All facilities with a potential to emit 25 tons per year or 10 tons per hour of sulfur dioxide shall comply with the limitation under this rule.  
  
The sulfur dioxide emissions from the process tanks are not subject to the emissions limitation under this rule, because the limitation are specifically for combustion facilities.
- (e) 326 IAC 2-4.1-1 (Toxics Control Rule)  
The proposed process tanks are not subject to 326 IAC 2-4.1 (New Source Toxics Control) because they are subject to 40 CFR Part 63 Subparts I, H, and GGG.
- (f) Applicable Requirements in Previous Permits Applicable to the Replaced Process Tanks; General Tank TK 26, General Tank TK 7, and General Tank TK 18:
  - (1) Permits PC (79) 1464, issued on May 21, 1980 and OP 79-04-90-0390, issued October 9, 1986 - These permits apply to the process tank in Building T-100 that will be replaced by the new General Tank TK26. These permits limited the VOC emissions from Buildings T-99 and T-100 to 80 pounds per day and 10 tons per year. Since the VOC limit is applicable to the whole processes in Buildings T-99 and T-100, it cannot be carried over to this significant source modification to apply to the replacement General Tank TK26. Therefore, Permits PC (79) 1464, issued on May 21, 1980 and OP 79-04-90-0390 shall remain enforceable and will apply to the new process tank General Tank TK26.
  - (2) Permits 79-04-90-0383, issued on October 9, 1986 and Registration CP 157-3005, issued on May 23, 1994 - These permits apply to the process tanks in Building T28 that will be replaced by the new General tank TK7 and General Tank TK18. There are no applicable requirements in these permits that will be carried over in this significant source modification to apply to the new General tank TK7 and General Tank TK18.

## Compliance Requirements

Permits issued under 326 IAC 2-7 are required to ensure that sources can demonstrate compliance with applicable state and federal rules on a more or less continuous basis. All state and federal rules contain compliance provisions, however, these provisions do not always fulfill the requirement for a more or less continuous demonstration. When this occurs IDEM, OAQ, in conjunction with the source, must develop specific conditions to satisfy 326 IAC 2-7-5. As a result, compliance requirements are divided into two sections: Compliance Determination Requirements and Compliance Monitoring Requirements.

Compliance Determination Requirements in Section D of the permit are those conditions that are found more or less directly within state and federal rules and the violation of which serves as grounds for enforcement action. If these conditions are not sufficient to demonstrate continuous compliance, they will be supplemented with Compliance Monitoring Requirements, also Section D of the permit. Unlike Compliance Determination Requirements, failure to meet Compliance Monitoring conditions would serve as a trigger for corrective actions and not grounds for enforcement action. However, a violation in relation to a compliance monitoring condition will arise through a source's failure to take the appropriate corrective actions within a specific time period.

The compliance monitoring requirements applicable to this modification are as follows:

1. Process Tanks General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 compliance monitoring requirements:
  - (a) The owner or operator shall implement the Leak Detection and Repair (LDAR) Program proposed by Eli Lilly, most recently approved by the Office of Air Quality, to reduce fugitive VOC emissions from processes that use methylene chloride. If it is not feasible to either pressure test a group of fugitive sources or

monitor a specific compound, then a written justification will be required for each source or compound exempted from testing. Any necessary adjustments to the procedures shall be submitted to the Office of Air Quality for approval prior to implementation.

- (b) The Permittee shall record the operating temperature of the Regenerative Thermal Oxidizers (RTOs) used in conjunction with the tanks at least once per week when the tanks are in operation and venting to the atmosphere. The operating temperature for the RTOs shall be maintained at 1600 °F, or the temperature determined during the most recent stack tests.
- (c) When the VOC emissions from the proposed process tanks are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3.
- (d) The RTOs or Condensers shall operate at all times the equipment being controlled are in operation.

These monitoring conditions are necessary because the Regenerative Thermal Oxidizers and the condensers must operate properly to ensure compliance with 326 IAC 8-5-3 (Synthesized Pharmaceutical Manufacturing Operations).

- (2) Stack testing for the new process tanks and centrifuge control equipment, to verify if all these new facilities are in compliance with 326 IAC 8-5-3, and if General Tank TK20, Centrifuge HF-3 and Mother Liquor Receiver Tank TK HF-3 comply with 326 IAC 2-2 will be deferred to follow the schedule in the Part 70 permit.

## Conclusion

The operation of the new process tanks and centrifuges shall be subject to the conditions of the attached **Significant Source Modification 157-14897-00006**.

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### **D.1 FACILITY OPERATION CONDITIONS - New and Replacement General Process Tanks**

**Malfunction Report**

**Certification**

**Affidavit**

## SECTION A

## SOURCE SUMMARY

This approval is based on information requested by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ). The information describing the emission units contained in conditions A.1 through A.2 is descriptive information and does not constitute enforceable conditions. However, the Permittee should be aware that a physical change or a change in the method of operation that may render this descriptive information obsolete or inaccurate may trigger requirements for the Permittee to obtain additional permits or seek modification of this approval pursuant to 326 IAC 2, or change other applicable requirements presented in the permit application.

### A.1 General Information [326 IAC 2-7-4(c)] [326 IAC 2-7-5(15)]

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The Permittee owns and operates a stationary source that produces pharmaceutical products.

Responsible Official:	Kenny McCleary
Source Address:	1650 Lilly Road, Lafayette, Indiana 47909
Mailing Address:	1650 Lilly Road, Lafayette, Indiana 47909
Phone Number:	765-477-4006
SIC Code:	2834 and 2879
County Location:	Tippecanoe
Source Location Status:	Attainment for all criteria pollutants
Source Status:	Part 70 Permit Program Major Source, under PSD or Emission Offset Rules; Major Source, Section 112 of the Clean Air Act

### A.2 Emission Units and Pollution Control Equipment Summary [326 IAC 2-7-4(c)(3)] [326 IAC 2-7-5(15)]

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This stationary source is approved to construct and operate the following emission units and pollution control devices:

- (a) New Process Tanks:
  - (1) One (1) General Process Tank, identified as TK20 to be installed in building T100 with a capacity of 4,000 gallons;
  - (2) One (1) Mother Liquor Receiver Tank, identified as TK-HF3 to be installed in building T28 with a capacity of 100 gallons;
  - (3) One (1) Centrifuge HF-3, to be installed in building T28; and
  - (4) Miscellaneous piping loop that will connect production buildings T28 and T100 with the existing solvent storage in building T146.
- (b) Replacement Tanks:
  - (1) One (1) General Process Tank, identified as TK7 to be installed in building T28 with a capacity of 2,000 gallons. The existing Tank TK7 is a 2,000 gallon stainless steel tank that will be replaced by a 2,000 gallon hastelloy tank.
  - (2) One (1) General Process Tank, identified as TK18 to be installed in building T28 with a capacity of 500 gallons. The existing Tank TK18 is a 750 gallon glass lined tank that will be replaced by a 500 gallon glass lined tank; and
  - (3) One (1) General Process Tank, identified as TK26 to be installed in building T100 with a capacity of 4,000 gallons. The existing Tank TK26 is a 4,000 gallon stainless steel tank that will be replaced by a 4,000 gallon hastelloy tank.

The point source emissions from the new and replacement process vessels may vent directly to RTO1 or RTO2, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process

vessels to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device that complies with 326 IAC 8-5-3.

**A.3 Part 70 Permit Applicability [326 IAC 2-7-2]**

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This stationary source submitted a Part 70 permit application TV157-6879-00006 on October 10, 1996, pursuant to 326 IAC 2-7-2 (Applicability) because:

- (a) It is a major source, as defined in 326 IAC 2-7-1(22);
- (b) It is a source in a source category designated by the United States Environmental Protection Agency (U.S. EPA) under 40 CFR 70.3 (Part 70 - Applicability).

## **SECTION B                      GENERAL CONSTRUCTION CONDITIONS**

### **B.1        Definitions [326 IAC 2-7-1]**

Terms in this permit shall have the definition assigned to such terms in the referenced regulation. In the absence of definitions in the referenced regulation, the applicable definitions found in the statutes or regulations (IC 13-11, 326 IAC 1-2 and 326 IAC 2-7) shall prevail.

### **B.2        Effective Date of the Permit [IC13-15-5-3]**

Pursuant to IC 13-15-5-3, this approval becomes effective upon its issuance.

### **B.3        Revocation of Permits [326 IAC 2-1.1-9(5)][326 IAC 2-7-10.5(i)]**

Pursuant to 326 IAC 2-1.1-9(5)(Revocation of Permits), the Commissioner may revoke this approval if construction is not commenced within eighteen (18) months after issuance of this approval or if construction is suspended for a continuous period of one (1) year or more.

### **B.4        Significant Source Modification [326 IAC 2-7-10.5(h)]**

This document shall also become the approval to operate pursuant to 326 IAC 2-7-10.5(h) when, prior to start of operation, the following requirements are met:

- (a)        The attached affidavit of construction shall be submitted to the Office of Air Quality (OAQ), Permit Administration & Development Section, verifying that the emission units were constructed as proposed in the application. The emissions units covered in the Significant Source Modification approval may begin operating on the date the affidavit of construction is postmarked or hand delivered to IDEM if constructed as proposed.
- (b)        If actual construction of the emissions units differs from the construction proposed in the application, the source may not begin operation until the source modification has been revised pursuant to 326 IAC 2-7-11 or 326 IAC 2-7-12 and an Operation Permit Validation Letter is issued.
- (c)        If construction is completed in phases; i.e., the entire construction is not done continuously, a separate affidavit must be submitted for each phase of construction. Any permit conditions associated with operation start up dates such as stack testing for New Source Performance Standards (NSPS) shall be applicable to each individual phase.
- (d)        The Permittee shall receive an Operation Permit Validation Letter from the Chief of the Permit Administration & Development Section and attach it to this document.
- (e)        This Significant Source Modification Approval shall be incorporated into the Permittee's Part 70 Operating permit application.

## SECTION C GENERAL OPERATION CONDITIONS

### C.1 Certification [326 IAC 2-7-4(f)][326 IAC 2-7-6(1)][326 IAC 2-7-5(3)(C)]

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- (a) Where specifically designated by this approval or required by an applicable requirement, any application form, report, or compliance certification submitted shall contain certification by a responsible official of truth, accuracy, and completeness. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.
- (b) One (1) certification shall be included, using the attached Certification Form, with each submittal where certification is required by the terms of the applicable rule or specifically designated by this approval.
- (c) A responsible official is defined at 326 IAC 2-7-1(34).

### C.2 Preventive Maintenance Plan [326 IAC 2-7-5(1),(3) and (13)] [326 IAC 2-7-6(1) and (6)] [326 IAC 1-6-3]

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- (a) If required by specific condition(s) in Section D of this approval, the Permittee shall prepare and maintain Preventive Maintenance Plans (PMPs) when operation begins, including the following information on each facility:
  - (1) Identification of the individual(s) responsible for inspecting, maintaining, and repairing emission control devices;
  - (2) A description of the items or conditions that will be inspected and the inspection schedule for said items or conditions; and
  - (3) Identification and quantification of the replacement parts that will be maintained in inventory for quick replacement.

If, due to circumstances beyond the Permittee's control, the PMPs cannot be prepared and maintained within the above time frame, the Permittee may extend the date an additional ninety (90) days provided the Permittee notifies:

Indiana Department of Environmental Management  
Compliance Branch, Office of Air Quality  
100 North Senate Avenue, P. O. Box 6015  
Indianapolis, Indiana 46206-6015

The PMP and the PMP extension notification do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

- (b) The Permittee shall implement the PMPs as necessary to ensure that failure to implement a PMP does not cause or contribute to a violation of any limitation on emissions or potential to emit.
- (c) A copy of the PMPs shall be submitted to IDEM, OAQ, upon request and within a reasonable time, and shall be subject to review and approval by IDEM, OAQ. IDEM, OAQ, may require the Permittee to revise its PMPs whenever lack of proper maintenance causes or contributes to any violation. The PMP does not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

- (d) Records of preventive maintenance shall be retained for a period of at least five (5) years. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.

**C.3 Permit Amendment or Modification [326 IAC 2-7-10.5]**

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- (a) Permit amendments and modifications are governed by the requirements of 326 IAC 2-7-10.5 whenever the Permittee seeks to amend or modify this permit.
- (b) Any application requesting an amendment or modification of this permit shall be submitted to:

Indiana Department of Environmental Management  
Permits Branch, Office of Air Quality  
100 North Senate Avenue, P.O. Box 6015  
Indianapolis, Indiana 46206-6015

Any such application shall be certified by the "responsible official" as defined by 326 IAC 2-7-1(34).

**C.4 Opacity [326 IAC 5-1]**

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Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in this permit:

- (a) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.
- (b) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

**C.5 Operation of Equipment [326 IAC 2-7-6(6)]**

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Except as otherwise provided by statute or rule, or in this permit, all air pollution control equipment listed in this permit and used to comply with an applicable requirement shall be operated at all times that the emission units vented to the control equipment are in operation.

**Testing Requirements [326 IAC 2-7-6(1)]**

**C.6 Performance Testing [326 IAC 3-6][326 IAC 2-1.1-11]**

---

- (a) Compliance testing on new emission units shall be conducted within 60 days after achieving maximum production rate, but no later than 180 days after initial start-up, if specified in Section D of this approval. All testing shall be performed according to the provisions of 326 IAC 3-6 (Source Sampling Procedures), except as provided elsewhere in this approval, utilizing any applicable procedures and analysis methods specified in 40 CFR 51, 40 CFR 60, 40 CFR 61, 40 CFR 63, 40 CFR 75, or other procedures approved by IDEM, OAQ.

A test protocol, except as provided elsewhere in this approval, shall be submitted to:

Indiana Department of Environmental Management

Compliance Data Section, Office of Air Quality  
100 North Senate Avenue, P. O. Box 6015  
Indianapolis, Indiana 46206-6015

no later than thirty-five (35) days prior to the intended test date. The protocol submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

- (b) The Permittee shall notify IDEM, OAQ of the actual test date at least fourteen (14) days prior to the actual test date. The notification submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).
- (c) Pursuant to 326 IAC 3-6-4(b), all test reports must be received by IDEM, OAQ within forty-five (45) days after the completion of the testing. An extension may be granted by IDEM, OAQ, if the source submits to IDEM, OAQ, a reasonable written explanation within five (5) days prior to the end of the initial forty-five (45) day period. The test report submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

#### **Compliance Requirements [326 IAC 2-1.1-11]**

##### **C.7 Compliance Requirements [326 IAC 2-1.1-11]**

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The commissioner may require stack testing, monitoring, or reporting at any time to assure compliance with all applicable requirements. Any monitoring or testing shall be performed in accordance with 326 IAC 3 or other methods approved by the commissioner or the U. S. EPA.

#### **Compliance Monitoring Requirements [326 IAC 2-7-5(1)] [326 IAC 2-7-6(1)]**

##### **C.8 Compliance Monitoring [326 IAC 2-7-5(3)] [326 IAC 2-7-6(1)]**

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If required by Section D, all monitoring and record keeping requirements shall be implemented when operation begins. The Permittee shall be responsible for installing any necessary equipment and initiating any required monitoring related to that equipment.

#### **Corrective Actions and Response Steps [326 IAC 2-7-5] [326 IAC 2-7-6]**

##### **C.9 Actions Related to Noncompliance Demonstrated by a Stack Test [326 IAC 2-7-5] [326 IAC 2-7-6]**

- 
- (a) When the results of a stack test performed in conformance with Section C - Performance Testing, of this approval exceed the level specified in any condition of this approval, the Permittee shall take appropriate response actions. The Permittee shall submit a description of these response actions to IDEM, OAQ, within thirty (30) days of receipt of the test results. The Permittee shall take appropriate action to minimize excess emissions from the affected facility while the response actions are being implemented.
  - (b) A retest to demonstrate compliance shall be performed within one hundred twenty (120) days of receipt of the original test results. Should the Permittee demonstrate to IDEM, OAQ that retesting in one-hundred and twenty (120) days is not practicable, IDEM, OAQ may extend the retesting deadline.
  - (c) IDEM, OAQ reserves the authority to take any actions allowed under law in response to noncompliant stack tests.

The documents submitted pursuant to this condition do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

## **Record Keeping and Reporting Requirements [326 IAC 2-7-5(3)] [326 IAC 2-7-19]**

### **C.10 Malfunctions Report [326 IAC 1-6-2]**

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Pursuant to 326 IAC 1-6-2 (Records; Notice of Malfunction):

- (a) A record of all malfunctions, including startups or shutdowns of any facility or emission control equipment, which result in violations of applicable air pollution control regulations or applicable emission limitations shall be kept and retained for a period of three (3) years and shall be made available to the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ) or appointed representative upon request.
- (b) When a malfunction of any facility or emission control equipment occurs which lasts more than one (1) hour, said condition shall be reported to OAQ, using the Malfunction Report Forms (2 pages) or equivalent. Notification shall be made by telephone or facsimile, as soon as practicable, but in no event later than four (4) daytime business hours after the beginning of said occurrence.
- (c) For malfunction lasting more than one (1) hour - failure to report a malfunction of any emission control equipment shall constitute a violation of 326 IAC 1-6, and any other applicable rules. Information of the scope and expected duration of the malfunction shall be provided, including the items specified in 326 IAC 1-6-2(a)(1) through (6).
- (d) Malfunction is defined as any sudden, unavoidable failure of any air pollution control equipment, process, or combustion or process equipment to operate in a normal and usual manner. [326 IAC 1-2-39]

### **C.11 General Record Keeping Requirements [326 IAC 2-7-5(3)][326 IAC 2-7-6]**

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- (a) Records of all required data, reports and support information shall be retained for a period of at least five (5) years from the date of monitoring sample, measurement, report, or application. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.
- (b) Unless otherwise specified in this permit, all record keeping requirements not already legally required shall be implemented upon start of operation.

## SECTION D.1 FACILITY OPERATION CONDITIONS

### Facility Description [326 IAC 2-7-5(15)]

- (a) New Process Tanks:
- (1) One (1) General Process Tank, identified as TK20 to be installed in building T100 with a capacity of 4,000 gallons;
  - (5) One (1) Mother Liquor Receiver Tank, identified as TK-HF3 to be installed in building T28 with a capacity of 100 gallons;
  - (6) One (1) Centrifuge HF-3, to be installed in building T28; and
  - (7) Miscellaneous piping loop that will connect production buildings T28 and T100 with the existing solvent storage in building T146.
- (b) Replacement Tanks:
- (1) One (1) General Process Tank, identified as TK7 to be installed in building T28 with a capacity of 2,000 gallons. The existing Tank TK7 is a 2,000 gallon stainless steel tank that will be replaced by a 2,000 gallon hastelloy tank.
  - (2) One (1) General Process Tank, identified as TK18 to be installed in building T28 with a capacity of 500 gallons. The existing Tank TK18 is a 750 gallon glass lined tank that will be replaced by a 500 gallon glass lined tank; and
  - (3) One (1) General Process Tank, identified as TK26 to be installed in building T100 with a capacity of 4,000 gallons. The existing Tank TK26 is a 4,000 gallon stainless steel tank that will be replaced by a 4,000 gallon hastelloy tank.

The point source emissions from the new and replacement process vessels may vent directly to RTO1 or RTO2, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessels to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device that complies with 326 IAC 8-5-3. The sulfur dioxide and nitrogen oxides emissions from these tanks are voluntarily controlled by caustic scrubbers.

(The information describing the process contained in this facility description box is descriptive information and does not constitute enforceable conditions.)

## SECTION D.1 FACILITY OPERATION CONDITIONS

### Emission Limitations and Standards

#### D.1.1 Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing [326 IAC 8-5-3]

- (a) Pursuant to 326 IAC 8-5-3 when using condensers to control the VOC emissions from these process tanks and centrifuge the outlet gas temperature shall not exceed the following:
- (1) minus twenty-five degrees Celsius (-25 °C) when condensing VOC of vapor pressure greater than forty (40) kilo Pascals (five and eight-tenths (5.8) pounds per square inch);

- (2) minus fifteen degrees Celsius ( $-15^{\circ}\text{C}$ ) when condensing VOC of vapor pressure greater than twenty (20) kilo Pascals (two and nine-tenths (2.9) pounds per square inch);
  - (3) zero degrees Celsius ( $0^{\circ}\text{C}$ ) when condensing VOC of vapor pressure greater than ten (10) kilo Pascals (one and five-tenths (1.5) pounds per square inch);
  - (4) ten degrees Celsius ( $10^{\circ}\text{C}$ ) when condensing VOC of vapor pressure greater than seven (7) kilo Pascals (one (1) pounds per square inch); or
  - (5) twenty -five degrees Celsius ( $25^{\circ}\text{C}$ ) when condensing VOC of vapor pressure greater than three and five-tenths (3.5) kilo Pascals (five-tenths (0.5) pounds per square inch).
- (b) Pursuant to 326 IAC 8-5-3(b)(1)(C), when using equivalent controls, the VOC emissions shall be reduced by at least as much as they would be by using a surface condenser which meets the requirements of conditions (a)(1) through (a)(5) as applicable. The approximate equivalent control efficiency for the RTO is 90%.
  - (c) Pursuant to 326 IAC 8-5-3(b)(5) the Permittee shall install covers on all in process tanks that contain VOCs. These covers shall be kept closed unless production sampling, maintenance, or inspection procedures require operator access.
  - (d) Pursuant to 326 IAC 8-5-3(b)(6) the Permittee shall repair all visible leaks from which a liquid, containing VOC can be observed running or dripping. The repair shall be completed the first time the equipment is off line for a period of time long enough to complete the repair.

D.1.2 National Emission Standards for Hazardous Air Pollutants (NESHAPs) 40 CFR Part 63, Subparts I and H

---

The owner or operator shall implement the Lilly Leak Detection and Repair (LDAR) Program, most recently approved by the Office of Air Quality, to reduce fugitive emissions from processes that use methylene chloride. If it is not feasible to either pressure test a group of fugitive sources or monitor a specific compound, then a written justification shall be required for each source or compound exempted from testing. Any necessary adjustments to the procedures shall be submitted to the Office of Air Quality for approval prior to implementation.

D.1.3 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production)

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The new process tanks are subject to the National Emission Standards for Hazardous Air Pollutants 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production) and shall be in compliance with this NESHAP by the compliance date.

General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 do not constitute a new or reconstruction of the affected source under Subpart GGG, nor do they constitute a new or reconstruction of a pharmaceutical manufacturing process unit (PMPU). Therefore, the existing source requirements of Subpart GGG shall apply.

## Compliance Determination Requirements

### D.1.4 Testing Requirements [326 IAC 2-7-6(1),(6)][326 IAC 2-1.1-11]

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The Permittee is not required to test the facilities by this permit. The testing required for these facilities will be deferred and shall follow the schedule in the Title V Permit, to determine compliance with 326 IAC 8-5-3. However, IDEM may require compliance testing when necessary to determine if the facilities are in compliance. If testing is required by IDEM compliance with Condition D.1.1 shall be determined by a performance test conducted in accordance with Section C - Performance Testing.

### D.1.5 Monitoring For VOC Emissions

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- (a) The VOC emissions from the new process tanks and centrifuge; General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 shall be in compliance with 326 IAC 8-5-3 provided that:
- (1) the Regenerative Thermal Oxidizers (RTO1 or RTO2) or Condensers (when Lilly elects to control the VOC by condensers) shall operate at all times the equipment being controlled are in operation and emitting VOC;
  - (2) when the VOC emissions from the proposed general process tanks and centrifuge are controlled by RTO1 or RTO2, the RTOs operating temperature shall be maintained at 1600 °F, or the temperature determined during the most recent stack tests, to maintain at least 90% destruction of the volatile organic compounds. The operating temperature of the RTOs shall be monitored continuously;
  - (3) when the VOC emissions from the proposed general process tanks and centrifuge are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3, see condition D.1.1;

## Record Keeping and Reporting Requirements

### D.1.6 Record Keeping Requirements

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- (a) The Permittee shall maintain records as follows:
- (1) The malfunction report of the RTOs; and applicable malfunction reports when the facility is emitting VOC, but not venting to the RTOs;
  - (2) Continuous records of the operating temperature of the RTOs during normal operation when General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 are emitting VOC;
  - (3) The number of hours the proposed process tanks and centrifuge; General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 were emitting VOC and vented to points other than the RTO or the condenser;
  - (4) The Permittee records the time during which the proposed process tanks and centrifuge were emitting VOC but the RTO or condensers, serving the proposed process tanks, were not operated;

- (5) The Permittee records the reason the RTO or condensers were not operated during the period referred to in (4);
  - (6) The Permittee records the corrective actions taken to bring the RTO or condensers to normal operation during the period referred to in (4).
- (b) All records shall be maintained in accordance with Section C - General Record Keeping Requirements, of this permit.

**INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT**  
Office of Air Quality  
**FAX NUMBER - 317 233-5967**

### **326 IAC 1-6-1 Applicability of rule**

Sec. 1. This rule applies to the owner or operator of any facility required to obtain a permit under 326 IAC 2-5.1 or 326 IAC 2-6.1.

### **326 IAC 1-2-39 "Malfunction" definition**

Sec. 39. Any sudden, unavoidable failure of any air pollution control equipment, process, or combustion or process equipment to operate in a normal and usual manner.

**\*Essential services** are interpreted to mean those operations, such as, the providing of electricity by power plants. Continued operation solely for the economic benefit of the owner or operator shall not be sufficient reason why a facility cannot be shutdown during a control equipment shutdown.

If this item is checked on the front, please explain rationale:

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**INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF AIR QUALITY  
COMPLIANCE DATA SECTION**

**PART 70 SOURCE MODIFICATION  
CERTIFICATION**

Source Name: Eli Lilly and Company - Tippecanoe Laboratories  
Source Address: 1650 Lilly Road, Lafayette, Indiana 47905  
Mailing Address: P.O. Box 685, Lafayette, Indiana 47902  
Source Modification No.: 157-14897-00006

**This certification shall be included when submitting monitoring, testing reports/results or other documents as required by this approval.**

Please check what document is being certified:

- 9 Test Result (specify) \_\_\_\_\_
- 9 Report (specify) \_\_\_\_\_
- 9 Notification (specify) \_\_\_\_\_
- 9 Affidavit (specify) \_\_\_\_\_
- 9 Other (specify) \_\_\_\_\_

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

Signature:

Printed Name:

Title/Position:

Date:

Mail to: Permit Administration & Development Section  
Office of Air Quality  
100 North Senate Avenue  
P. O. Box 6015  
Indianapolis, Indiana 46206-6015

Eli Lilly and Company - Tippecanoe Laboratories  
P.O. Box 685  
Lafayette, Indiana 47902

#### Affidavit of Construction

I, \_\_\_\_\_, being duly sworn upon my oath, depose and say:  
(Name of the Authorized Representative)

1. I live in \_\_\_\_\_ County, Indiana and being of sound mind and over twenty-one (21) years of age, I am competent to give this affidavit.
2. I hold the position of \_\_\_\_\_ for \_\_\_\_\_.  
(Title) (Company Name)
3. By virtue of my position with \_\_\_\_\_, I have personal  
(Company Name)  
knowledge of the representations contained in this affidavit and am authorized to make  
these representations on behalf of \_\_\_\_\_.  
(Company Name)
4. I hereby certify that Eli Lilly and Company - Tippecanoe Laboratories has constructed the following facilities:
  - (a) New Process Tanks:
    - (1) One (1) General Process Tank, identified as TK20 to be installed in building T100 with a capacity of 4,000 gallons;
    - (2) One (1) Mother Liquor Receiver Tank, identified as TK-HF3 to be installed in building T28 with a capacity of 100 gallons;
    - (3) One (1) Centrifuge HF-3, to be installed in building T28; and
    - (4) Miscellaneous piping loop that will connect production buildings T28 and T100 with the existing solvent storage in building T146.
  - (b) Replacement Tanks:
    - (1) One (1) General Process Tank, identified as TK7 to be installed in building T28 with a capacity of 2,000 gallons. The existing Tank TK7 is a 2,000 gallon stainless steel tank that will be replaced by a 2,000 gallon hastelloy tank;
    - (2) One (1) General Process Tank, identified as TK18 to be installed in building T28 with a capacity of 500 gallons. The existing Tank TK18 is a 750 gallon glass lined tank that will be replaced by a 500 gallon glass lined tank; and
    - (3) One (1) General Process Tank, identified as TK26 to be installed in building T100 with a capacity of 4,000 gallons. The existing Tank TK26 is a 4,000 gallon stainless steel tank that will be replaced by a 4,000 gallon hastelloy tank. in conformity with the requirements and intent of the construction permit application received by the Office of Air Quality on (? date) and as permitted pursuant to **Source Modification No. 159-14897-00006** issued on \_\_\_\_\_
5. Additional (?operations/facilities) were constructed/substituted as described in the attachment to this document and were not made in accordance with the Significant Source Modification. (Delete this statement if it does not apply.)

Eli Lilly and Company - Tippecanoe Laboratories  
Lafayette, Indiana  
Permit Reviewer: Aida De Guzman

Page 18 of 18  
Significant Source Modification No. 157-14897-00006

Further Affiant said not.

I affirm under penalties of perjury that the representations contained in this affidavit are true, to the best of my information and belief.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

STATE OF INDIANA)  
  )SS

COUNTY OF \_\_\_\_\_ )

Subscribed and sworn to me, a notary public in and for \_\_\_\_\_ County and State of Indiana on  
this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

My Commission expires: \_\_\_\_\_

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name (typed or printed)

## Indiana Department of Environmental Management Office of Air Quality

### Addendum to the Technical Support Document for a Part 70 Significant Source Modification

Source Name: Eli Lilly and Company, Tippecanoe Laboratories  
Source Location: 1650 Lilly Road, Lafayette, Indiana 47909  
County: Tippecanoe  
SIC Code: 2834 and 2879  
Operation Permit No.: TV 157-6879-00006 Issuance Date: Pending  
Significant Source Modification: 157-14897-00006  
Permit Reviewer: Aida De Guzman

On November 10, 2001, the Office of Air Quality (OAQ) had a notice published in the Journal and Courier, Lafayette, Indiana, stating that Eli Lilly and Company had applied for a Part 70 Significant Source Modification to construct and operate process tanks and replacement tanks with existing RTO1 or RTO2 to control the VOC and HAP emissions. The notice also stated that OAQ proposed to issue a permit for this construction and operation and provided information on how the public could review the proposed permit and other documentation. Finally, the notice informed interested parties that there was a period of thirty (30) days to provide comments on whether or not this permit should be issued as proposed.

The source has made the following comments to the proposed permit (changes are bolded and deletions are struck-through for emphasis):

- Comment 1: Delete reference to responsible official in paragraph A.1 because certifications by responsible officials are Title V requirements and Lilly does not have a Title V permit yet. Therefore, these requirements do not apply to Lilly at this time.
- Response 1: The source is a Part 70 source, and the proposed Significant Source Modification is issued pursuant to 326 IAC 2-7-10.5, which is a rule under the Part 70 permit program. Therefore, the responsible official referenced in Section A.1 will not be deleted.
- Comment 2: Condition B.4 (5) - This paragraph should not be numbered B.4(5). Replace "=" with " ".
- Response 2: The formatting changed when the draft document was e-mailed to you, however the draft hardcopy does not have these formatting problems.
- Comment 3: Delete condition C.1 entirely because certifications by responsible officials are Title V permit requirements and Lilly does not have a Title V permit yet. Therefore, these requirements do not apply to Lilly at this time.
- Response 3: Condition C.1 will not be deleted, since the source is a Part 70 source. Certification is required for submitting Affidavit. Although parametric monitoring is not required to be reported regularly, it will require certification when requested by IDEM, OAQ.
- Comment 4: On Condition C.2 delete the following:  
(a) Delete "A" before responsible official and the "@" after official  
(b) Delete comma at the end of the first sentence.

- (c) Delete the following per previous permits and appeals ~~"IDEM, OAQ may require the Permittee to revise its PMP whenever lack of proper maintenance causes or contributes to a violation."~~

Response 4: (a) This was a formatting problem when the draft permit was e-mailed to you. The original draft does not have this problem.

(b) On section C.2(c), the comma was deleted at the end of the first sentence.

(c) In the very first permit model, condition C.2(c) did not have the language you sought to be deleted. However due to its vagueness as stated in the appeals, IDEM, OAQ had expanded the condition and added this language "IDEM, OAQ may require the Permittee to revise its PMP whenever lack of proper maintenance causes or contributes to a violation". OAQ believes that this language is necessary related to PMP revision. Therefore, no changes will be made to this condition.

Comment 5: Condition C.2 (c)(7) should be deleted. Lilly has successfully requested that this condition be deleted from previous MSMA's (157-10818-00006 issued on May 25, 1999 and MSMA 157-11183-00006 issued on October 26, 1999.

- (7) ~~Records of preventive maintenance shall be retained for a period of at least five (5) years. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time~~

Response 5: At the time this condition was deleted in previous permits, the new permitting program was just at its conception and no guidance was in place. The time period for record keeping required in this condition was based on the record keeping time period in 326 IAC 3-5-6. This condition will not be deleted in this case. Condition C.2(c)(7) should be C.2(d).

Comment 6: Delete reference to responsible official, ~~"Any such application shall be certified by the responsible official" as defined by 326 IAC 2-7-1(34)".~~

Delete paragraph C.3(c) since 326 IAC 2-7-10.5 applies.

Response 6: The following statement will stay since it might be applicable if amendment or modification of this permit is made. "Any such application should be certified by the "responsible official" as defined by 326 IAC 2-7-1(34) only if a certification is required by the terms of the applicable rule."

The following Condition C.3(c) is deleted since it is not applicable.

- C.3(c) ~~The Permittee may implement administrative amendment changes addressed in the request for an administrative amendment immediately upon submittal of the request. [326 IAC 2-7-11(e)(3)]~~

Comment 7: Delete condition C.5 Fugitive Dust Emissions, because the tanks do not have fugitive dust emissions.

- Response 7: Condition C.5 was deleted in the permit. Subsequent conditions have been re-numbered accordingly.
- Comment 8: Add quotes around responsible official in condition C.7(c) and delete "A" and "@"
- Response 8: Quotes were added around responsible official. "A" and "@" were not found in the draft permit. The formatting most probably changed and created the characters mentioned when the document was e-mailed to you. No further changes were made to the condition. C.7(c) is now C.6(c).
- Comment 9: Delete "and record keeping requirements..." in condition C.9 because record keeping is covered in section C.13(b).
- Response 9: Condition C.9, now C.8 is simply cross referencing the record keeping requirements in this condition because record keeping is a part of compliance monitoring. No changes were made to the permit.
- Comment 10: Condition C.10, should be deleted. This condition requires the Permittee to implement a Compliance Monitoring Plan, including a Compliance Response Plan. The language in this condition is duplicative of language contained in Section D, which spells out clearly the compliance monitoring requirements. Restating those requirements in condition C.10 is duplicative and unnecessary and could result in multiple violations occurring from a single act or emission. Furthermore, these conditions are in excess of IDEM's authority.
- Response 10: IDEM, OAQ has determined that conditions in D.1.3 are **Compliance Determination** conditions rather than **Compliance Monitoring** conditions; and Conditions D.1.4 and D.1.5 are **Emission Limitations and Standards** conditions. Since there are no more conditions left under Compliance Monitoring Requirements in Section D, condition C.10, now C.9 **Compliance Monitoring Plan** will also be deleted.
- Comment 11: Condition C.13 (b) should be changed to the following:
- (b) Unless otherwise specified in this permit, all record keeping requirements not already legally required shall be implemented within ninety (90) days of when operation begin.
- Response 11: IDEM, OAQ has inadvertently required record keeping in Condition C.13(b), now C.11(b) to be implemented within ninety (90) days... For new source construction, record keeping requirements must be **upon start of operation**. Condition C.13(b) now C.11(b) is revised as follows:
- (b) Unless otherwise specified in this permit, all record keeping requirements not already legally required shall be implemented ~~within ninety (90) days of permit issuance~~ **upon start of operation**.
- Comment 12: Condition C.14 should be deleted since there are no reporting requirements .
- Response 12: Condition C.14 will be deleted since Section D of the permit does not have reporting requirements.
- Comment 13: Delete equals sign after VOC on D.1.1(c) and add comma after VOC on D.1.1(d).
- Response 13: The condition has been checked, the equals sign after VOC is not in the draft permit. No change was made to this section, comma was added after VOC on section D.1.1(c).

Comment 14: In order to clarify monitoring and record keeping requirements, Lilly requests that Condition D.1.3 be modified so as to list only monitoring requirements. Specifically D.1.3(a)(2) should be revised to state that the Permittee shall monitor the operating temperature of the RTOs at least once weekly when the proposed general process tanks and centrifuge are emitting VOC. When the VOC emissions from the proposed general tanks and centrifuge are controlled by RTO1 or RTO2, the RTOs operating temperature shall be maintained at 1600 °F , or the temperature determined during the most recent stack tests, to maintain at or the temperature determined during the most recent stack tests, to maintain at least 90% destruction of the volatile organic compounds. The last sentence of D.1.3(a)(2), and paragraph D.1.3(a)(4) - (7) should be deleted. These subsections set forth record keeping requirements rather than monitoring requirements . A separate section for record keeping is provided in Condition D.1.6.

Response 14: Condition D.1.3(2) monitoring frequency of the RTO temperature shall stay the same as in the draft permit "continuously" instead of weekly, because the source must demonstrate continuous compliance with the rule and not intermittent compliance. Therefore this condition will stay the same. To be consistent with the daily monitoring of the RTO temperature, condition D.1.6(a)(2) will be changed to "continuously" instead of "weekly" as stated in the draft permit.

For the clarification, the monitoring and record keeping requirements will be separated. Condition D.1.3 and D.1.6 were revised as follows:

#### D.1.3 Monitoring For VOC Emissions

- 
- (a) The VOC emissions from the new process tanks and centrifuge; General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 shall be in compliance with 326 IAC 8-5-3 provided that:
- (1) the Regenerative Thermal Oxidizers (RTO1 or RTO2) or Condensers (when Lilly elects to control the VOC by condensers) shall operate at all times the equipment being controlled are in operation and emitting VOC;
  - (2) when the VOC emissions from the proposed general process tanks and centrifuge are controlled by RTO1 or RTO2, the RTOs operating temperature shall be maintained at 1600 °F, or the temperature determined during the most recent stack tests, to maintain at least 90% destruction of the volatile organic compounds. The operating temperature of the RTOs shall be ~~recorded and~~ monitored continuously;
  - (3) when the VOC emissions from the proposed general process tanks and centrifuge are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3, see condition D.1.1;
  - ~~(4) the Permittee records the time during which the proposed process tanks and centrifuge were emitting VOC but the RTO or condensers, serving the proposed process tank, were not operated;~~
  - ~~(5) the Permittee records the reason the RTO or condensers were not operated during the period referred to in (4);~~
  - ~~(6) the Permittee records the corrective actions taken to bring the RTO or condensers to normal operation during the period referred to in (4); and~~
  - ~~(7) the Permittee records the number of hours the proposed process tanks and~~

~~centrifuge, were emitting VOC and vented to points other than the RTO or a condenser complying with 326 IAC 8-5-3.~~

#### D.1.6 Record Keeping Requirements

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- (a) The Permittee shall maintain records as follows:
- (1) The malfunction report of the RTOs; and applicable malfunction reports when the facility is emitting VOC, but not venting to the RTOs;
  - (2) **Weekly Continuous** records of the operating temperature of the RTOs during normal operation when General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 are emitting VOC;
  - (3) The number of hours the proposed process tanks and centrifuge; General Tank TK20, General Tank TK26, General Tank TK7, General Tank TK18, Centrifuge HF-3, and Mother Liquor Receiver Tank TK HF-3 **were emitting VOC and vented to points other than the RTO or the condenser;**
  - (4) **The Permittee records the time during which the proposed process tanks and centrifuge were emitting VOC but the RTO or condensers, serving the proposed process tanks, were not operated;**
  - (5) **The Permittee records the reason the RTO or condensers were not operated during the period referred to in (4);**
  - (6) **The Permittee records the corrective actions taken to bring the RTO or condensers to normal operation during the period referred to in (4).**

#### Changes to the TSD

Comment 1: Under Federal Rule Applicability (a)(1) change the reason why 326 IAC 12, 40 CFR Part 60, Subpart Kb is not applicable to the tanks because they are less than 40 cubic meters (10,500 gallons) in volume. Change it to the following:

- (a) New Source Performance Standards (NSPS):
- (1) 326 IAC 12, 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for which construction, reconstruction, or modification commenced after July 23, 1994. This NSPS is not applicable to the new tanks, **because they are process tanks and not storage tanks, the tanks are less than 40 cubic meters (10,500 gallons) in volume.**

Response 1: The reason made under section (a)(1) in the Federal Rule Applicability determination for the proposed process tanks will stay as it is, since the tanks are process tanks. However, the source comments will be added, as follows:

### **Federal Rule Applicability**

- (a) New Source Performance Standards (NSPS):
  - (1) 326 IAC 12, 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for which construction, reconstruction, or modification commenced after July 23, 1994. This NSPS is not applicable to the new tanks, because they are process tanks and not storage tanks, **and they are less than 40 cubic meters (10,500 gallons) in volume.**

# Appendix A

## Emissions Calculations

Source Location: 1650 Lilly Road, Lafayette, Indiana 47909  
County: Tippecanoe  
SIC Code: 2834 & 2879  
Part 70 Operation Permit No.: TV157-6879-00006 Issuance Date: Pending  
Significant Source Modification No.: 157-14897-00006  
Permit Reviewer: Aida De Guzman

Eli Lilly and Company has submitted an application relating to the following construction:

- (a) New Process Tanks:
  - (1) One (1) General Process Tank, identified as TK20 to be installed in building T100 with a capacity of 4,000 gallons;
  - (2) One (1) Mother Liquor Receiver Tank, identified as TK-HF3 to be installed in building T28 with a capacity of 100 gallons;
  - (3) One (1) Centrifuge HF-3, to be installed in building T28; and
  - (4) Miscellaneous piping loop that will connect production buildings T28 and T100 with the existing solvent storage in building T146.
- (b) Replacement Tanks:
  - (1) One (1) General Process Tank, identified as TK7 to be installed in building T28 with a capacity of 2,000 gallons. The existing Tank TK7 is a 2,000 gallon stainless steel tank that will be replaced by a 2,000 gallon hastelloy tank.
  - (2) One (1) General Process Tank, identified as TK18 to be installed in building T28 with a capacity of 500 gallons. The existing Tank TK18 is a 750 gallon glass lined tank that will be replaced by a 500 gallon glass lined tank; and
  - (3) One (1) General Process Tank, identified as TK26 to be installed in building T100 with a capacity of 4,000 gallons. The existing Tank TK26 is a 4,000 gallon stainless steel tank that will be replaced by a 4,000 gallon hastelloy tank.

Eli Lilly and Company (Lilly) is a research based corporation involved in the development, manufacturing and marketing of human and animal health products.

The process vessels can be used in a variety of operations involved in pharmaceutical manufacturing. These operations are mainly batch in nature and include, but are not limited to heating, cooling, distilling (atmospheric and vacuum), extracting, crystallizing, chemical synthesis, cryogenic service, and associated operations.

The point source emissions from these process vessels may vent directly to the RTO, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessel to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device.

The process used to model the emissions from the general process vessels is a worst case process designed to give a maximum emissions estimate for any process that may be run in this piece of equipment. While general process vessels are only used in the production of bulk pharmaceutical drugs, the type of products manufactured will vary with the market demand.

The emission calculations assume the control device is a condenser with exit gas temperature of  $-15^{\circ}\text{C}$ . The VOC emissions leaving the condensers are calculated assuming ideal liquid and vapor equilibrium at a given temperature and pressure. The condenser is used in the calculations since it provides the level of emission control that would be required to comply with 326 IAC 8-5-

3. This demonstrates that the control efficiency required to comply with 326 IAC 8-5-3 is approximately 90 percent. When condensers are used to control VOC emissions, these condensers will achieve an efficiency of 90%. The actual VOC control device normally used on the tank will be either an existing condenser in series with the existing RTO, or the RTO alone. The RTO alone has demonstrated to achieve in excess of 95% VOC reduction and therefore meets the and exceeds the requirements of 326 IAC 8-5-3. Lilly would like to maintain the flexibility to use condensers during the RTO malfunction.

Emissions calculations for point source VOC emissions from all tanks were performed by the applicant, using the equations found in the EPA guideline for control of volatile organic compounds emissions from manufacture of synthesized pharmaceutical products, EPA-450/2-78-029. To estimate the maximum potential uncontrolled and allowable VOC emissions for each piece of equipment, acetone was used as solvent in the emission calculations and 8760 hours/year operating schedule was assumed to get a worst case potential emissions scenario. For all processes, acetone although a non-photochemically reactive hydrocarbon, was used in the calculations because it has the highest volatility among the solvent utilized. Since solvents with vapor pressures as high as that of acetone are not always used in the processes, the assumption used in the calculations will generate a worst case estimate for the potential VOC emissions.

The various assumptions used in calculating emissions from different process activities may be found with the relevant equations in the sample calculations. For this application, the process tank VOC emission estimates are based on a combination of the typical unit operations that are done to perform a process. The steps in the model process include charging, heating, tank evacuation with vacuum distillations, and atmospheric distillations. For example, a distillation process can include a tank evacuation, a heating step, and a distillation step.

During distillation operations, the condenser on a process vessel is not considered to be a pollution device. It is classified as a process control device because it is vital to production of the normal product of the distillation. No other process operations will have condensers as the pollution control device.

The calculations for the controlled point source VOC emissions from the process tank assumes that the pollution control device is a condenser (exit gas temperature  $-15^{\circ}\text{C}$ ). The VOC emissions leaving the condensers are calculated assuming ideal liquid and vapor in equilibrium at a given temperature and pressure.

#### **LILLY VENT EMISSION PROGRAM FOR POINT SOURCES:**

- (a) Applicability of Calculation: The program is used to calculate point source VOC emissions from batch processes.
- (b) Source or Basis of Calculation: The basis for the program are the equations found in EPA's Control Techniques Guideline for Synthetic Pharmaceutical Manufacturing (450/2-78-028, 1978, Appendix B).
- (c) Process Vessel Calculation Assumption:
  - (1) Pure acetone is used in all calculations.
  - (2) The vessel contains perfectly mixed ideal liquid and vapor phases, and they are continuously in phase equilibrium.
  - (3) The vapor leaving the vessel is assumed to have the same composition as the vapor in the tank's vapor space.
  - (4) The streams leaving the condensers, where used, are calculated assuming ideal

liquid and vapor in equilibrium at the given temperature and pressure.

- (5) The amount of liquid being vaporized in the tank is assumed to be small compared to the total liquid volume. Therefore, the liquid composition and the volume of the vapor space can be assumed to be constant.
- (6) The control device is a condenser that will produce an exit gas temperature of  $-15^{\circ}\text{C}$  (per 326 IAC 8-5-3 for acetone) under all loading, or an equivalent control device that will have the same control efficiency as this condenser.
- (7) VOC emissions are from the tanks themselves, not ancillary existing equipment.
- (8) Nitrogen purge rate for inerting purposes is 5 scfh.
- (9) Charging into a tank is at 60 gallons per minute.
- (10) Tanks are charged 2/3 full of acetone for all tank sizes.
- (11) The tank is assumed to start each operation 2/3 full, except for "charging" where the tank is empty at the start. The vapor space is assumed to be composed of gaseous  $\text{N}_2$  in equilibrium with acetone vapor at the stated temperature.
- (12) The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over 1/2 of the liquid volume. In the 4,000 gallon tank case, however, only 1/3 of the liquid is distilled. The time required to distill more solvent would push the Possible Process Chain's time over 24 hours.
- (13) During the atmospheric distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of  $23^{\circ}\text{C}$  ( $55^{\circ}\text{F}$  cooling water =  $12.78^{\circ}\text{C} + 10^{\circ}\text{C}$  approach =  $22.78 \sim 23^{\circ}\text{C}$ ). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of  $-15^{\circ}\text{C}$ , or a control device with the same control efficiency. The emissions from this condenser are listed in the potential controlled column.
- (14) There is a 5 scfh nitrogen purge during all atmospheric distillations.
- (15) "Evacuation" means evacuating the tank from atmospheric pressure down to 1 mmHg above the vapor pressure of acetone at  $20^{\circ}\text{C}$ .
- (16) The Vacuum Distillation inert leak rate is 0.5 scfm for all tank sizes and vacuum levels. This is the average leak rate.
- (17) The Vacuum Distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at  $20^{\circ}\text{C}$ , then distilling over 2 of the liquid volume.
- (18) During the Vacuum Distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of  $0^{\circ}\text{C}$  ( $-10^{\circ}\text{C}$  brine +  $10^{\circ}\text{C}$  approach =  $0^{\circ}\text{C}$ ). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of  $-15^{\circ}\text{C}$ , or a control device with the same control efficiency. The emissions from this condenser are listed in the allowable column.
- (19) The Pressure Transfer operation consists of pressuring-up the tank with nitrogen from 1 to 2 atmospheres to force the liquid out of the tank. When the tank is empty, this pressure is released from the tank.

- (20) There are no process condensers on the purge, charge, heat from 20°C to 55°C, evacuation, or de-pressurization steps. A condenser is not needed to perform these operations.
- (21) It is assumed that during the time the tank is not performing a set of steps that it can be doing another operation that the 24 hour sweep will account for that operation's emissions, i.e., stirring, cooling.
- (22) "Per Step" emissions are for performing the given step, or series of steps, once.
- (23) "Yearly" emissions are for performing the given step, or series of steps, once per day, 365 days per year.
- (24) Efficiencies are calculated according to the following formula:

$$\text{Efficiency} = \frac{100\% \text{ Potential Uncontrolled Emissions} - \text{After Controlled Emissions}}{\text{Potential Uncontrolled Emissions}}$$

#### CALCULATIONS NOMENCLATURE

a,b,c	-	Antoine coefficients
i	-	The ith. component
K <sub>ideal</sub>	-	Vapor/liquid equilibrium constant
LMPD	-	Log mean pressure difference (mm Hg)
L	-	Total moles in liquid phase (lb-mole)
L <sub>i</sub>	-	Moles of component i in liquid phase (lb-mole)
M	-	Mass(lb)
M <sub>i</sub>	-	Mass of component i (lb)
m	-	Mass rate (lb/hr)
m <sub>i</sub>	-	Mass rate of component i (lb/hr)
MW	-	Molecular weight (lb/lb-mole)
MW <sub>i</sub>	-	Molecular weight of component i (lb/lb-mole)
N or V	-	Total moles in vapor phase (lb-mole)
n	-	Molar rate (lb-mole/hr)
N <sub>i</sub> or V <sub>i</sub>	-	Moles of component i in vapor phase (lb-mole)
n <sub>i</sub>	-	Molar rate of component i (lb-mole/hr)
P or P <sub>total</sub>	-	Total Pressure (mm Hg)
P <sub>i</sub>	-	Partial pressure of component i (mm Hg)
p <sub>0</sub>	-	Vapor pressure (mm Hg)
p <sub>i</sub>	-	Vapor pressure of component i (mm Hg)
R	-	Ideal Gas Constant (10.73 ft <sup>3</sup> psia/lb-mole °R)
T	-	Temperature in Kelvin (K) or Rankine(R)
t	-	Temperature in Celsius (C) or Fahrenheit (F)
V	-	Volume (ft <sup>3</sup> )
V or N	-	Total moles in vapor phase (lb-mole)
V <sub>i</sub> or N <sub>i</sub>	-	Moles of component i in vapor phase (lb-mole)
v	-	Volumetric rate (gpm for liquid, cfm for vapor or gas)
x <sub>i</sub>	-	Liquid mole fraction of component i
y <sub>i</sub>	-	Vapor mole fraction of component i
Z	-	Total moles entering condenser (lb-mole)
Z <sub>i</sub>	-	Total moles of component i entering condenser (lb-mole)

#### **CALCULATION THEORY/SAMPLE CALCULATIONS:**

Note: All VOC emissions were calculated using Eli Lilly and Company's Vent Emission Program. The following sample calculations use the same equations as those in the program, The sample

calculation results, however, may differ slightly due to rounding of significant digits.

Physical Properties:

Acetone:

Molecular weight = 58.08

Antoine Coefficients (-59.4°C to 56.5°C )

a = 16.82

b = 2993

c = -35.63

Specific gravity @ 20°C = 0.792

Nitrogen(gaseous):

Molecular weight = 28

Possible Operation Step A: N<sub>2</sub> inerting purge @ 5 scfh:

Tanks that contain a flammable liquid(s) or a VOC(s) are purged with gaseous N<sub>2</sub> to keep the vapor space above the liquid inert. As a continuous stream of N<sub>2</sub> flows into the tank, N<sub>2</sub> becomes saturated with vapor that is in equilibrium with the liquid. An emission is created as this N<sub>2</sub>/vapor mixture leaves the tank.

Liquid temperature = 293.15° K (20°C)

Vessel Pressure = 760 mm Hg

Pure acetone is in the tank during this step, so the mole fraction of liquid component (x<sub>A</sub>) is 1.

Potential uncontrolled VOC emissions:

Vapor pressure calculation: Using the Antoine Equation at liquid temperature (20°C),

$$\begin{aligned} \ln(PA^0 \text{ (mmHg)}) &= [a - (b/(T(^{\circ}K) + c))] \\ PA^0 \text{ mmHg} &= \exp [a - (b/(T(^{\circ}K) + c))] \\ &= \exp [16.82 - (2993/(293.15 - 35.63))] \\ &= 180.84 \text{ mmHg} \end{aligned}$$

Equilibrium Concentration: Raoult's Law states that the partial pressure of acetone, P<sub>A</sub>, can be calculated by multiplying the vapor pressure, P<sub>A</sub><sup>0</sup>, by the liquid mole fraction, x<sub>A</sub>, which equals the total pressure, P, multiplied by the vapor mole fraction, y<sub>A</sub>.

$$(P)(y_A) = (P A^0)(x_A) = P A$$

Rearranging yields:

$$\begin{aligned} y_A/x_A &= P A^0/P = K_{ideal} \\ y_A &= (K_{ideal})(x_A) \\ &= (180.84/760)(1) \\ &= 0.2379 \end{aligned}$$

Inert Sweep Rate: It is assumed that the amount of N<sub>2</sub> entering the tank leaves the tank at the same rate. It is assumed that the N<sub>2</sub> stream enters the tank at 70°F (530°R) and 14.72 psia. Using the ideal gas law;

$$\begin{aligned} PV &= nRT \\ PV &= (m/MW)RT && \text{Since: } n = m/MW \\ m &= PV(MW)/RT \end{aligned}$$

The mass flow rate, m, is:

$$\begin{aligned} m_{N_2} \text{ (lb/hr)} &= \{v(\text{cfh})(MWN_2)(14.72 \text{ psia})\}/(R)(530^{\circ}R) \\ &= \{(5 \text{ scfh})(28)(14.72 \text{ psia})\}/(10.73)(530^{\circ}R) \\ &= 0.3624 \text{ lb/hr} \end{aligned}$$

For 24 hours:

$$\begin{aligned} M_{N_2} \text{ (lb)} &= (0.3624 \text{ lb/hr})(24 \text{ hrs}) \\ &= 8.70 \text{ lb} \end{aligned}$$

Mass of acetone leaving the system: The number of moles of volatile components leaving the tank is related to the number of moles leaving the system and the partial pressure of the volatile and inert compounds. For a one component system:

$$(P_A)(v) = (n_A)(R)(T)$$

For the inert sweep, v, R, and T are assumed constant. Therefore, the ratio of moles of inert to volatile compounds can be calculated as:

$$\begin{aligned} P_A/P_{N_2} &= n_A/n_{N_2} && \text{Since: } n_{N_2} = m_{N_2}/MW_{N_2} \\ &= (n_A)(MW_{N_2})/m_{N_2} \\ &= (m_A)(MW_{N_2})/(m_{N_2})(MW_A) && \text{Since: } n_A = m_A/MW_A \\ P_A/(P-P_A) &= (m_A)(MW_{N_2})/(m_{N_2})(MW_A) && \text{Since: } P_{N_2} = P-P_A \end{aligned}$$

The mass rate of acetone vapor emitted by the N<sub>2</sub> sweep is:

$$\begin{aligned} m_A \text{ (lb/hr)} &= (m_{N_2}/MW_{N_2})(MW_A)(P_A/(P_A-P)) \\ &= (0.3624/28)(58.08)(180.84/(760-180.84)) \\ &= 0.2347 \text{ lb/hr} \end{aligned}$$

For 24 hours:

$$\begin{aligned} MA \text{ (lb/day)} &= (0.2347 \text{ lb/hr})(24 \text{ hrs}) \\ &= 5.63 \text{ lb/day} \end{aligned}$$

This compares to 5.73 lb as calculated by the Emission Calculation Program.

#### Allowable

Allowable VOC emissions are based on the emission control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15<sup>0</sup> C, to ensure compliance with 326 IAC 8-5-3 for acetone.

Vapor pressure calculation: Using the Antoine Equation at -15<sup>0</sup>C,

$$\begin{aligned} \ln(P_A \text{ (mmHg)}) &= [a - (b/(T(^0K) + c))] \\ P_A \text{ (mmHg)} &= \exp [a - (b/(T(^0K) + c))] \\ &= \exp [16.82 - (2993/(258.15 - 35.63))] \\ &= 29.06 \text{ mmHg} \end{aligned}$$

$$K_{\text{ideal}} = 29.06/760 = 0.0382$$

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser:

$$Z = V + L$$

Likewise for each component:

$$\begin{aligned} Z_i &= V_i + L_i && \text{Where } L_i = 0 \text{ for inert} \\ \text{or } Z_i &= (V)(y_i) + (L)(x_i) && \text{for volatile compounds} \\ Z_i &= (V)(y_i) && \text{for inert compounds} \\ Z_i &= (V)(K_{\text{ideal}})(x_i) + (L)(x_i) && \text{Since } K_{\text{ideal}} = y_i/x_i \\ Z_i/L &= (V/L)(K_{\text{ideal}})(x_i) + (x_i) \\ Z_i/L &= [(V/L)(K_{\text{ideal}}) + 1](x_i) \\ Z_i/[(V/L)(K_{\text{ideal}}) + 1] &= (L)(x_i) = L_i \\ L_i &= Z_i/[(V/L)(K_{\text{ideal}}) + 1] \end{aligned}$$

To solve the mass balance for the number of moles in the liquid and vapor phases:

- (1) Assume a V/L ratio (where V is total molar volume including the inert gases)
- (2) Calculate the liquid moles of each volatile component by:  

$$L_i = \frac{Z_i}{[(V/L)(K_{ideal}) + 1]}$$
- (3) Calculate the vapor moles of each volatile component by:  

$$V_i = Z_i - L_i$$
- (4) The moles of inert out of the condenser is equal to the moles into the condenser, which has been calculated previously.
- (5) Sum the volatile component liquid moles (L) and the volatile and inert component vapor moles (V) and compute the ratio V/L.
- (6) The computed V/L is compared to the assumed V/L. If they are not equal, a new iteration is performed using the calculated V/L.

The following table shows the values used for the iteration:

Iteration	Assumed V/L	Calculated		$V_{N_2}$	Calculated V/L
		LA	VA		
1	0.50	0.0952	0.0018	0.3106	3.28
2	3.28	0.0862	0.0108	0.3106	3.73
3	3.73	0.0849	0.0121	0.3106	3.80
4	3.80	0.0847	0.0123	0.3106	3.81
5	3.81	0.0847	00.0123	0.3106	3.81

The mass of each component is related to its moles by:

$$\begin{aligned}
 M_i(\text{lbs}) &= (V_i)(MW_i) \\
 M_A(\text{lbs}) &= (0.0123)(58.08) \\
 &= 0.71 \text{ lb}
 \end{aligned}$$

Possible operation Step B: Charge 2000 gallon tank 2/3 full:

This calculation models the emissions associated with the displacement of vapor from a tank that is being filled with a VOC. The tank in this case is filled 2/3 full with acetone at 20 °C at 60 gallons per minute. The tank is assumed to be filled with gaseous  $N_2$  before charging, and the displaced vapor is  $N_2$ , 100 % saturated with acetone.

$$\begin{aligned}
 \text{Liquid temperature} &= 293.15^{\circ}\text{K} \text{ ( } 20^{\circ}\text{C)} \\
 \text{Tank pressure} &= 760 \text{ mmHg}
 \end{aligned}$$

Pure acetone is charged into the tank during this step, so the mole fraction of liquid component ( $x_A$ ) is 1.

Potential VOC emissions:

Volume of charged material:

$$\begin{aligned}
 V_L &= (2000 \text{ gallons})(2/3) = 1333.33 \text{ gallons} \\
 &= (2000 \text{ gal})(1\text{ft}^3/7.4805 \text{ gal})(2/3) = 178.24 \text{ ft}^3
 \end{aligned}$$

This is also equal to the volume of inert being displaced.

Molar displacement rate of inerts:

The volatile and inert vapor partial pressures are related by:

$$P_{\text{Total}} = P_A + P_{N_2}$$

The partial pressure of  $N_2$  is then:

$$\begin{aligned} P_{N_2} &= P_{\text{Total}} - P_A \\ &= (760) - (180.84) \\ &= 579.16 \text{ mmHg} \\ &= (579.16 \text{ mmHg})(14.696 \text{ psia}/760 \text{ mmHg}) \\ &= 11.20 \text{ psia} \end{aligned}$$

Applying Dalton's Law:

$$\begin{aligned} n_{N_2} &= (P_{N_2})(V_L)/[(R)(T)] \\ &= (11.20 \text{ psia})(178.24 \text{ ft}^3)/((10.73)(527.67)) \\ &= 0.3526 \text{ lbmoles} \end{aligned}$$

Mass of Acetone leaving the tank:

The mass rate of acetone vapor emitted by the liquid displacement:

$$\begin{aligned} M_A(\text{lb}) &= (M_{N_2})(MW_A)(P_A/P_{N_2}) \\ &= (0.3526)(58.08)(180.84)/(579.16) \\ &= 6.39 \text{ lbs} \end{aligned}$$

This compares to 6.39 lbs as calculated by the Emission Calculation Program.

#### Allowable

Allowable VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of  $-15^\circ\text{C}$ .

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's Potential Controlled calculation method.

The resulting VA of the iterative calculation is: 0.0140

The mass of each component is related to its moles by:

$$\begin{aligned} M_i(\text{lbs}) &= (V_i)(MW_i) \\ M_A(\text{lbs}) &= (0.0140)(58.08) \\ &= 0.81 \text{ lb} \end{aligned}$$

This compares to 0.81 lb as calculated by the Emission Calculation Program.

#### Possible operation Step C: Heat tank contents from $20^\circ\text{C}$ to $55^\circ\text{C}$ :

This calculation models the emissions associated with the displacement of vapor from acetone that is being heated from  $20^\circ\text{C}$  to  $55^\circ\text{C}$ . The vapor space above the liquid is assumed to consist of gaseous  $N_2$  saturated with acetone vapor. As the liquid heats up, it vaporizes and displaces the vapor above it, causing an emission from the tank.

$$\begin{aligned} \text{Initial liquid temperature} &= 293.15^\circ\text{K} (20^\circ\text{C}, 527.67^\circ\text{R}) \\ \text{Final liquid temperature} &= 328.15^\circ\text{K} (55^\circ\text{C}, 626.67^\circ\text{R}) \\ \text{Tank pressure} &= 760 \text{ mmHg} \end{aligned}$$

Volume of acetone in tank:

$$\begin{aligned} V_L &= (2000 \text{ gallons})(2/3) = 1333.33 \text{ gallons} \\ &= (1333.3 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gal})(2/3) = 178.24 \text{ ft}^3 \end{aligned}$$

Volume of vapor space:

$$\begin{aligned} V_{VS} &= (2000 \text{ gallons})(1/3) = 666.67 \text{ gallons} \\ &= (666.67 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gal})(1/3) = 89.12 \text{ ft}^3 \end{aligned}$$

Pure acetone is in the tank during this step, so the mole fraction of liquid component ( $x_A$ ) is 1.

#### Potential Uncontrolled:

Vapor Pressures: Initial and final vapor pressures are calculated using the Antoine equations as previously shown.

Initial:

$$\begin{aligned} \text{Acetone, } P^0_{A,I} &= 180.84 \text{ mmHg (3.50 psia)} & K_{\text{Ideal},I} &= 0.2379 \\ \text{Nitrogen, } P^0_{N_2,I} &= 579.16 \text{ mmHg (11.20 psia)} \end{aligned}$$

Final:

$$\begin{aligned} \text{Acetone, } P^0_{A,F} &= 726.49 \text{ mmHg (14.05 psia)} & K_{\text{Ideal},F} &= 0.9559 \\ \text{Nitrogen, } P^0_{N_2,F} &= 33.51 \text{ mmHg (0.65 psia)} \end{aligned}$$

Change in moles of inert in vapor space between initial and final conditions:

$$\begin{aligned} N_{N_2,I} - N_{N_2,F} &= \left[ \left( \frac{P_{N_2,I}}{T_I} \right) - \left( \frac{P_{N_2,F}}{T_F} \right) \right] (V_{VS}) / (R) \\ &= \left[ \left( \frac{11.20}{527.67} \right) - \left( \frac{0.65}{626.67} \right) \right] (89.12) / (10.73) \\ &= 0.1677 \text{ lbmoles} \end{aligned}$$

Amount of acetone being displaced from the tank:

The total number of moles in the vapor space and the vapor phase composition are both functions of temperature. Since the molar rate at which vapors leave the tank is greatly influenced by the components partial pressure, it is assumed that for any component:

$$N_i / (\text{LMPD})_i = \text{Constant}$$

Where  $N_i$  is the number of moles of component  $i$  having left the tank, and the Log Mean Pressure Difference of  $i$ ,  $(\text{LMPD})_i$ , is calculated as follows:

$$\begin{aligned} (\text{LMPD})_i &= (P_I - P_F)_i / \ln(P_I/P_F)_i \\ (\text{LMPD})_A &= (180.84 - 726.49)_A / \ln(180.84/726.49)_A \\ &= 392.38 \end{aligned}$$

$$\begin{aligned} (\text{LMPD})_{N_2} &= (579.16 - 33.51)_{N_2} / \ln(579.16/33.51)_{N_2} \\ &= 190.75 \end{aligned}$$

Therefore, the number of moles of inerts leaving the vessel and the LMPD of the inert and the volatile components, the number of moles of acetone can be estimated by:

$$N_A = (N_{N_2})(\text{LMPD})_A / (\text{LMPD})_{N_2}$$

And the mass of acetone leaving the tank is:

$$\begin{aligned} M_A \text{ (lbs)} &= (N_{N_2})[(\text{LMPD})_A / (\text{LMPD})_{N_2}](MW_A) \\ &= (0.1677)[(392.38)/(190.75)](58.08) \\ &= 20.04 \text{ lb} \end{aligned}$$

This compares to 19.89 lb as calculated by the Emissions Calculation Program.

#### Allowable

Allowable VOC emissions are based on emissions from the control device. In these calculations it

is assumed to be a surface condenser that produces an exit vapor temperature of  $-15^{\circ}\text{C}$

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's Allowable calculation method.

The resulting  $V_A$  of the iterative calculation is: 0.0067

The mass of each component is related to its moles by:

$$\begin{aligned} M_i (\text{lbs}) &= (V_i)(MW_i) \\ M_A (\text{lbs}) &= (0.0067)(58.08) \\ &= 0.39 \text{ lbs} \end{aligned}$$

This compares to 0.39 lb as calculated by the Emission Calculation Program.

#### Possible Operation Step D: Atmospheric Distillation

The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over 2 of the liquid volume. During the atmospheric distillations, there are two condensers. The first is a process control condenser that produces an exit gas temperature of  $23^{\circ}\text{C}$  ( $55^{\circ}\text{F}$  cooling water =  $12.78^{\circ}\text{C} + 10^{\circ}\text{C}$  approach =  $22.78^{\circ}\text{C} \sim 23^{\circ}\text{C}$ ). The second is an emission control condenser that produces an exit gas temperature of  $-15^{\circ}\text{C}$ , or a control device with the same control efficiency.

Heating acetone to its boiling point is modeled using the method outlined in Step C. The distillation is modeled using the method outlined in Step A with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

#### Possible Operation Steps E & F: Vacuum Distillation

The Vacuum distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at  $20^{\circ}\text{C}$ , then distilling over 2 of the liquid volume. Because the system is under vacuum, and it is not perfectly sealed, air leaks into the system. During the vacuum distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of  $0^{\circ}\text{C}$  ( $-10^{\circ}\text{C}$  brine +  $10^{\circ}\text{C}$  approach =  $0^{\circ}\text{C}$ ). The second is an emission control condenser that produces an exit gas temperature of  $-15^{\circ}\text{C}$ , or a control device with the same control efficiency.

Evacuating the tank to acetone's boiling point (at  $20^{\circ}\text{C}$ ) is modeled using the method outlined below. The air leakage during the distillation is modeled using the method outlined in Step A with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

$$\begin{aligned} \text{Liquid temperature} &= 293.15 \text{ K } (20^{\circ}\text{C}, 527.67^{\circ}\text{R}) \\ \text{Initial tank pressure} &= 760 \text{ mmHg} \end{aligned}$$

Volume of acetone in tank:

$$\begin{aligned} V_L &= (2000 \text{ gallons})(2/3) = 1,333.33 \text{ gallons} \\ &= (2000 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gallons})(2/3) = 178.24 \text{ ft}^3 \end{aligned}$$

Volume of vapor space:

$$\begin{aligned} V_{VS} &= (2000 \text{ gallons})(1/3) = 666.67 \text{ gallons} \\ &= (2000 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gallons})(1/3) = 89.12 \text{ ft}^3 \end{aligned}$$

Pure acetone is in the tank during this step, so the mole fraction of liquid component ( $X_A$ ) is 1.

#### Potential Uncontrolled:

Vapor Pressures: Calculated using the Antoine equations as previously shown.

Initial:

$$\begin{aligned} \text{Acetone, } P^{\circ}_{A,l} &= 180.84 \text{ mmHg } K_{\text{ideal},A} = 0.2379 \\ \text{Nitrogen, } P^{\circ}_{N_2,l} &= 579.16 \text{ mmHg} \end{aligned}$$

Mass of  $N_2$  evacuated from tank: Since the vapor pressures of acetone and  $N_2$  are constant, as well as the vapor space and temperature, the moles of acetone also remain constant, i.e., as any acetone vapor leaves the system, it is replaced by an equal amount from the liquid phases. The decrease in pressure, therefore, is due to the evacuation of  $N_2$ . The number of moles of  $N_2$  leaving the system are calculated by:

$$\begin{aligned} (N_{N_2, \text{Initial}} - N_{N_2, \text{Final}}) &= (P_{\text{Initial}} - P_{\text{Final}})(V_{\text{VS}})/[(R)(T)] \\ &= ((14.696 - 3.5)(89.12))/(10.73)(527.67) \\ &= 0.1762 \text{ lbmoles} \end{aligned}$$

Mass of Volatiles evacuated from tank: Using the LMPD method as described in Step C (Heat tank contents from  $20^{\circ}\text{C}$  to  $55^{\circ}\text{C}$ ) the mass of acetone leaving the tank is calculated by:

$$\begin{aligned} (\text{LMPD})_{N_2} &= (P_1 - P_F)_{N_2} / \ln(P_1/P_F)_{N_2} \\ &= (579.16 - 0.16) / \ln(579.16/0.16) \\ &= 70.66 \end{aligned}$$

$$\begin{aligned} M_A \text{ (lbs)} &= [(N_{N_2})/(\text{LMPD})_{N_2}](MW_A)(P_A) \\ &= [(0.1762)/(70.66)](58.08)(180.84) \\ &= 26.19 \text{ lb} \end{aligned}$$

This compares to 26.15 lb as calculated by the Emission Calculation Program.

#### Allowable

Allowable VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of  $-15^{\circ}\text{C}$ .

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is similar to Step A's potential controlled calculation method.

The resulting  $V_A$  of the iterative calculation is: 0.0337

The mass of each component is related to its moles by:

$$\begin{aligned} M_i \text{ (lbs)} &= (V_i)(MW_i) \\ M_A \text{ (lbs)} &= (0.0337)(58.08) \\ &= 1.96 \text{ lb} \end{aligned}$$

This compares to 1.96 lb as calculated by the Emissions Calculation Program.

### VOC Point Source Emissions Estimate for Gen'I Tank TK 7 (2,000 Gallon)

Possible Operation Steps	Temp(°C)	VOC Emissions lb/step	
		PU	PC
N2 inerting Purge @ 5 scfh	20	5.73	0.73
Charge 2,000 gallons tank 2/3 full of acetone	20	6.4	0.81
Heat from 20°C to 55°C	20-55	19.89	0.39
Atmospheric Distillation: Heat from 20°C to 56.3°C 5 scfh N2 purge during distillation	20-56.3 56.3	46.39 1.72	0.41 0.41
Vacuum Distillation: Evacuation Sweep (0.5 scfm leak rate) Depressurization from 2 to 1 atmospheres	20 20 20	26.15 16.42 8.04	1.96 5.24 1.60

Possible Process Chain for 1 day		VOC Emissions (lb/step)		VOC Emissions (pounds/year)		Control Efficiency
		PU	PC	PU	PC	
Charge-Vac. Dist. Depressurize	B-E-F-G	57.0	9.61	20,805	3,507.65	90%
Charge-Atm. Dist.-Depressurize	B-D-G	62.54	3.00	22,827.1	1,095.0	
Charge-Heat- Depressurize	B-C-G	34.32	2.80	12,526.8	1,022.0	
Charge-Heat- Depressurize	B-C-G	34.32	2.80	12,526.8	1,022.0	
Charge-Nothing- Depressurize	B-G	14.43	2.41	5,266.95	879.65	
24 Hour Sweep	A	5.73	0.73	2,091.45	266.45	
Total (Pounds)		208.34	21.35	76,044.1	7,792.75	
Total (tons)		0.10	0.01	38.02	3.90	

### VOC Point Source Emissions Estimate for Gen'I Tank TK 18 (500 Gallon)

Possible Operation Steps	Temp(°C)	VOC Emissions lb/step	
		PU	PC
N2 inerting Purge @ 5 scfh	20	5.73	0.73
Charge 500 gallons tank 2/3 full of acetone	20	1.6	0.20
Heat from 20°C to 55°C	20-55	4.97	0.10
Atmospheric Distillation: Heat from 20°C to 56.3°C 5 scfh N2 purge during distillation	20-56.3 56.3	11.60 0.43	0.10 0.05
Vacuum Distillation: Evacuation Sweep (0.5 scfm leak rate) Depressurization from 2 to 1 atmospheres	20 20 20	6.54 4.10 2.01	0.49 1.31 0.40

Possible Process Chain for 1 day		VOC Emissions (lb/step)		VOC Emissions (pounds/year)		Control Efficiency
		PU	PC	PU	PC	
Charge-Vac. Dist. Depressurize	B-E-F-G	14.25	2.40	5,201.25	876.00	90%
Charge-Atm. Dist.-Depressurize	B-D-G	15.21	0.70	5,551.65	255.50	
Charge-Heat- Depressurize	B-C-G	8.58	0.70	3,131.70	255.50	
Charge-Heat- Depressurize	B-C-G	8.58	0.70	3,131.70	255.50	
Charge-Nothing- Depressurize	B-G	3.61	0.60	1,317.65	219.00	
24 Hour Sweep	A	5.73	0.73	2,091.45	266.45	
Total (Pounds)		55.96	5.83	20,425.40	2,127.955	
Total (tons)		0.03	0.00	10.21	1.06	

**VOC Point Source Emissions Estimate for Gen'I Tank TK 20 and TK26 (4,000 Gallon)**

Possible Operation Steps	Temp(°C)	VOC Emissions lb/step	
		PU	PC
N2 inerting Purge @ 5 scfh	20	5.73	0.73
Charge 500 gallons tank 2/3 full of acetone	20	12.79	1.63
Heat from 20°C to 55°C	20-55	39.79	0.77
Atmospheric Distillation: Heat from 20°C to 56.3°C 5 scfh N2 purge during distillation	20-56.3 56.3	92.78 2.29	0.81 0.24
Vacuum Distillation: Evacuation Sweep (0.5 scfm leak rate) Depressurization from 2 to 1 atmospheres	20 20 20	52.31 32.84 16.08	3.92 10.47 3.21

Possible Process Chain for 1 day		VOC Emissions (lb/step)		VOC Emissions (pounds/year)		Control Efficiency
		PU	PC	PU	PC	
Charge-Vac. Dist. Depressurize	B-E-F-G	114.02	19.23	41,617.3	7,018.95	90%
Charge-Atm. Dist.-Depressurize	B-D-G	123.94	5.89	45,238.1	2,149.85	
Charge-Heat- Depressurize	B-C-G	68.66	5.61	25,060.90	2,047.65	
Charge-Nothing- Depressurize	B-G	28.87	4.84	10,537.55	1,766.60	
24 Hour Sweep	A	5.73	0.73	2,091.45	266.45	
Total (Pounds)		341.22	36.30	124,545.30	13,249.50	
Total (tons) 1 tank		0.17	0.02	62.27	6.62	
Total (tons) 2 tank		0.34	0.04	124.54	13.24	

### VOC Point Source Emissions Estimate for Mother Liquor Receiver Tank TK-HF3 (100 Gallon)

Possible Operation Steps	Temp(°C)	VOC Emissions lb/step	
		PU	PC
N2 inerting Purge @ 5 scfh	20	5.73	0.73
Charge 100 gallons tank 2/3 full of acetone	20	0.32	0.04

Possible Process Chain for 1 day		VOC Emissions (lb/step)		VOC Emissions (pounds/year)		Control Efficiency
		PU	PC	PU	PC	
Charge- 4 times per hour	B	30.72	3.84	11212.80	1401.60	90%
24 Hour Sweep	A	5.73	0.73	2,091.45	266.45	
Total (Pounds)		36.45	4.57	13304.25	1668.05	
Total (tons)		0.02	0.00	6.65	0.83	

Note:

PU - Potential uncontrolled emissions before pollution control device  
PC - Potential controlled emissions. Control device is a vent condenser or equivalent controls to meet 326 IAC 8-5-3 requirements.

### Emission Calculations:

The test data was performed on a 1:20,000 scale basis for a process run in a 2,000 gallon scale building. Process uses 63.5 grams of COCl<sub>2</sub>. Assume all is converted to CO (this is a very conservative assumption).

100 lots per year was used in the worst case potential emissions calculation. This maximum emission rate is much higher than any tank itself will emit, but because it is difficult to estimate how much of the emissions can be attributed to each tank alone, the entire building emission is assumed to come from each tank itself. As stated earlier, when summing the total emissions this factor is taken into account by looking at the maximum emitting tank for each building. Since process stoichiometry is based on bulk facility building scale, scaled emissions from all processes to appropriate size of the new tanks.

### CO Emissions:

$$\begin{aligned} \text{Lb CO/lot} &= 63.5 \text{ g COCl}_2/\text{lot} * \text{gr mole COCl}_2/98.92 \text{ gr} \\ &\quad * \text{gr mole CO/gr mole COCl}_2 * 28 \text{ gr CO/ gr mole CO} * 1\text{lb}/454 \\ &\quad \text{gr} \\ &= 0.0396 \text{ Lb CO/lot} \end{aligned}$$

(a) Gen'l Tank TK 20 and TK 26 (4,000 gallons):

$$\begin{aligned} \text{CO} &= 0.0396 \text{ lb CO/ lot} * 20,000 \text{ bldg size/1sample size} * 100 \text{ lots/yr} \\ &\quad * 4,000 \text{ gal}/2,000 \text{ gal} * \text{ton}/2000 \text{ lbs} \\ &= 79.2 \text{ tons/yr each tank} \end{aligned}$$

(b) Gen'l Tank TK7 (2,000 gallons):

$$\begin{aligned} \text{CO} &= 0.0396 \text{ lb CO/lot} * 20,000 \text{ bldg size/1sample size} * 100 \text{ lots/yr} \\ &\quad * 2,000 \text{ gal}/2,000 \text{ gal} * \text{ton}/2000 \text{ lbs} \end{aligned}$$

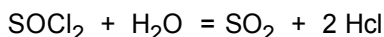
$$= 39.6 \text{ tons/yr}$$

(c) Gen'l Tank TK18 (500 gallons):

$$\begin{aligned} \text{CO} &= 0.0396 \text{ lb CO/lot} * 20,000 \text{ bldg size/sample size} * 100 \text{ lots/yr} \\ &= 79.2 \text{ tons/yr} \end{aligned}$$

### SO<sub>2</sub> Emissions:

Based on the stoichiometry from process with worst case SO<sub>2</sub> emissions:



$$\begin{aligned} \text{Lb SO}_2/\text{lot} &= 1023 \text{ kg SOCl}_2/\text{lot} * \text{kg mole SOCl}_2/118.97 \text{ kg} \\ &= 1212 \text{ Lb SO}_2/\text{lot (for a 2,000 gallon tank)} \end{aligned}$$

(a) Gen'l Tank TK26 (4,000 gallons):

$$\begin{aligned} \text{SO}_2 &= 1212 \text{ kg SOCl}_2/\text{lot} * 100 \text{ lots/yr} * 4,000 \text{ gal/2,000 gal} \\ &= 121.20 \text{ tons/yr} \end{aligned}$$

(b) Gen'l Tank TK7 (2,000 gallon):

$$\begin{aligned} \text{SO}_2 &= 1212 \text{ kg SOCl}_2/\text{lot} * 100 \text{ lots/yr} * 2,000 \text{ gal/2,000 gal} \\ &= 60.60 \text{ tons/yr} \end{aligned}$$

(c) Gen'l Tank TK18 (500 gallon):

$$\begin{aligned} \text{SO}_2 &= 1212 \text{ kg SOCl}_2/\text{lot} * 100 \text{ lots/yr} * 500 \text{ gal/2,000 gal} * \text{ton/2000 lb} \\ &= 15.15 \text{ tons/yr} \end{aligned}$$

### NO<sub>x</sub> Emissions:

Reaction 1:



92.3 kg of NaNO<sub>2</sub> will be reacted with HCl, therefore:

$$(92.3 \text{ kg NaNO}_2) * (1000 \text{ gr/kg}) * (1 \text{ mol/69 gr NaNO}_2) = 1338 \text{ mol NaNO}_2$$

1338 mol NaNO<sub>2</sub> yield 1338 mol HNO<sub>2</sub>

Reaction 2:



Only half of the 1338 mol HNO<sub>2</sub> available reacts. Therefore, 669 mol of N<sub>2</sub>O are formed, 669 mol of HNO<sub>2</sub> remain. Nitrous Oxide (N<sub>2</sub>O) is stable and inert.

Total NO<sub>2</sub> Formed:

$$\begin{array}{ccc} 669 \text{ mol NO}_2 & \text{Y} & 669 \text{ mol NO}_2 \\ \text{Formed from unreacted HNO}_2 & & \text{NO}_2 \text{ evolved/lot} \end{array}$$

$$\begin{aligned} \text{Lb NO}_x/\text{lot} &= 669 \text{ mol NO}_2/\text{lot} * 46.01 \text{ gr/mol NO}_2 * \text{lb/454 gr} * 100 \text{ lots/yr} \\ &= 6780 \text{ lb Nox/lot (for a 2,000 gallon tank)} \end{aligned}$$

- (a) Gen'l Tank TK20 & TK26 (4,000 gallons):  
NOx = 6780 lb NOx/lot \* 4,000 gal/2000 gal \* ton/2,000 lbs  
= 6.78 tons/yr each tank
- (b) Gen'l Tank TK 7 (2,000 gallons):  
NOx = 6780 lb NOx/lot \* 2,000 gal/2,000 gal \* ton/2000 lb  
= 3.39 tons/yr
- (c) Gen'l Tank TK18 (500 gallons):  
NOx = 6780 lb NOx/lot \* 500 gal/2,000 gal \* ton/2000 lb  
= 0.85 tons/yr

### Inorganic HAP Emission Calculations

Inorganic HAP

Basis: Worst case HAP emitting process (emits 1829 Hcl per lot from a 4,000 gallon tank)

#### HCl Emissions:

- (a) Gen'l Tank TK20 and TK26 (4,000 gallons):  
HCl = 1829 lb HCl /lot tech \* 4,000 gal/4,000 gal  
\* 1 lot tech/1,108 bkg tech \* 1.152 bkg tech/ 1 kilo final  
\* 50,000 kilos/yr \* ton/2000 lb  
= 47.53 ton/yr each tank
- (b) Gen'l Tank TK7 (2,000 gallons):  
HCl = 1829 lb HCl /lot tech \* 2,000 gal/4,000 gal  
\* 1 lot tech/1,108 bkg tech \* 1.152 bkg tech/ 1 kilo final  
\* 50,000 kilos/yr \* ton/2000 lb  
= 23.77 ton/yr each tank
- (c) Gen'l Tank TK18 (500 gallons):  
HCl = 1829 lb HCl /lot tech \* 500 gal/4,000 gal  
\* 1 lot tech/1,108 bkg tech \* 1.152 bkg tech/ 1 kilo final  
\* 50,000 kilos/yr \* ton/2000 lb  
= 5.94 ton/yr
- (d) Mother Liquor Receiver Tank TK-HF3 (100 gallons):  
HCl = 1829 lb HCl /lot tech \* 100 gal/4,000 gal  
\* 1 lot tech/1,108 bkg tech \* 1.152 bkg tech/ 1 kilo final  
\* 50,000 kilos/yr \* ton/2000 lb  
= 1.19 ton/yr

#### VOC Emission Calculations:

VOC emissions were calculated using Eli Lilly and Company's Vent Emissions Program. The program uses equations found in EPA's Control Technique Guidelines for Synthetic Pharmaceutical Manufacturing and material balance. The following calculations use the same equations as those in the Lilly Vent Emission Program. Acetone was chosen as the model substance because it is the most volatile of Lilly's commonly used solvents.

General Assumptions:

- (a) The vessel contains perfectly mixed ideal liquid and vapor phases, and they are continuously in phase equilibrium.

- (b) The vapor leaving the vessel is assumed to have the same composition as the vapor in the vessel's vapor space.
- (c) The streams leaving the condensers, where used, are calculated assuming ideal liquid and vapor in equilibrium at the given temperature and pressure.
- (d) It is assumed that the amount of liquid being vaporized in the vessels is small when compared to the total liquid volume, therefore, the liquid composition and the volume of the vapor space can be assumed to be constant.

### Centrifuge HF-3 - VOC and HAP Emissions from Nitrogen (N<sub>2</sub>) Purge @ 2 scfm

During filtration and washing operations, a centrifuge is purged with not more than 2 scfm gaseous N<sub>2</sub> for 24 hours per day and 365 days per year. This assumes maximum utilization of this equipment in building T28. As a continuous stream of N<sub>2</sub> flows into the centrifuge, N<sub>2</sub> becomes saturated with vapor that is in equilibrium with any liquid present. An emission is created as this N<sub>2</sub>/vapor mixture leaves the vessel.

$$\begin{aligned}\text{Liquid temperature} &= 298.15^\circ \text{ K } (20^\circ \text{ C}) \\ \text{Vessel Pressure} &= 760 \text{ mm Hg}\end{aligned}$$

Pure acetone is in the tank during this step, so the mole fraction of liquid component (x<sub>A</sub>) is 1.

#### Potential uncontrolled VOC emissions:

Vapor pressure calculation: Using the Antoine Equation at liquid temperature (20°C),

$$\begin{aligned}\ln(PA^\circ \text{ (mmHg)}) &= [a-(b/(T(^{\circ}\text{K})+c))] \\ PA^\circ \text{ mmHg} &= \exp [a-(b/(T(^{\circ}\text{K}) + c))] \\ &= \exp [16.82 - (2993/(298.15 - 35.63))] \\ &= 225.65 \text{ mmHg}\end{aligned}$$

Inert Sweep Rate: It is assumed that the amount of N<sub>2</sub> entering the tank leaves the tank at the same rate. It is assumed that the N<sub>2</sub> stream enters the tank at 70°F (530°R) and 14.72 psia. Using the ideal gas law;

$$\begin{aligned}PV &= nRT \\ PV &= (m/MW)RT && \text{Since: } n = m/MW \\ m &= PV(MW)/RT\end{aligned}$$

The mass flow rate, m, is:

$$\begin{aligned}m_{N_2} \text{ (lb/hr)} &= \{v(\text{cfh})(MWN_2)(14.72 \text{ psia})\}/(R)(520^\circ \text{ R}) \\ &= \{(120 \text{ scfh})(28)(14.72 \text{ psia})\}/(10.73)(520^\circ \text{ R}) \\ &= 8.85 \text{ lb/hr}\end{aligned}$$

$$\begin{aligned}\text{Molar Basis} \\ Z_{N_2} &= (8.85 \text{ lb/hr})/(28 \text{ lb/lb-mole}) \\ &= 0.316 \text{ lb-mole/hr}\end{aligned}$$

Mass of acetone leaving the system: The number of moles of volatile components leaving the tank is related to the number of moles leaving the system and the partial pressure of the volatile and inert compounds. For a one component system:

$$(P_A)(v) = (n_A)(R)(T)$$

For the inert sweep, v, R, and T are assumed constant. Therefore, the ratio of moles of inert to volatile compounds can be calculated as:

$$\begin{aligned} P_A/P_{N_2} &= n_A/n_{N_2} && \text{Since: } n_{N_2} = m_{N_2}/MW_{N_2} \\ &= (n_A)(MW_{N_2})/m_{N_2} \\ &= (m_A)(MW_{N_2})(m_{N_2})(MW_A) && \text{Since: } n_A = m_A/MW_A \\ P_A/(P-P_A) &= (m_A)(MW_{N_2})/(m_{N_2})(MW_A) && \text{Since: } P_{N_2} = P - P_A \end{aligned}$$

The mass rate of acetone vapor emitted by the N<sub>2</sub> sweep is:

$$\begin{aligned} m_A(\text{lb/hr}) &= (m_{N_2}/MW_{N_2})(MW_A)(P_A/(P_A-P)) \\ &= (8.85/28)(58.08)(225.65/(760-225.65)) \\ &= 7.75 \text{ lb/hr} \end{aligned}$$

For 24 hours:

$$\begin{aligned} MA \text{ (lb/day)} &= (7.75 \text{ lb/hr})(24 \text{ hrs}) \\ &= 186.1 \text{ lb/day} \end{aligned}$$

$$\begin{aligned} MA \text{ (ton/yr)} &= 186.1 \text{ lb/day} * 365 \text{ days/yr} * \text{ton}/2000 \text{ lb} \\ &= 33.9 \text{ tons/yr} \end{aligned}$$

Molar Basis:

$$\begin{aligned} Z_A &= (7.75 \text{ lb/hr}) / (58.08 \text{ lb/lb-mole}) \\ &= 0.133 \text{ lb-mole/hr} \end{aligned}$$

### ALLOWABLE EMISSIONS

Allowable VOC emissions are based on the emission control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15°C, to ensure compliance with 326 IAC 8-5-3 for acetone.

Vapor pressure calculation: Using the Antoine Equation at -15°C,

$$\begin{aligned} \ln(P_A(\text{mmHg})) &= [a-(b/(T(^{\circ}\text{K})+c))] \\ P_A(\text{mmHg}) &= \exp[a-(b/(T(^{\circ}\text{K})+c))] \\ &= \exp[16.82 - (2993/(258.15 - 35.63))] \\ &= 29.06 \text{ mmHg} \end{aligned}$$

$$\begin{aligned} K_{\text{ideal}} &= 29.06/760 \\ &= 0.0382 \end{aligned}$$

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser:

$$Z = V + L$$

Likewise for each component:

$$\begin{aligned} Z_i &= V_i + L_i && \text{Where } L_i = 0 \text{ for inert} \\ \text{or } Z_i &= (V)(y_i) + (L)(x_i) && \text{for volatile compounds} \\ Z_i &= (V)(y_i) && \text{for inert compounds} \\ Z_i &= (V)(K_{\text{ideal}})(x_i) + (L)(x_i) && \text{Since } K_{\text{ideal}} = y_i/x_i \\ Z_i/L &= (V/L)(K_{\text{ideal}})(x_i) + (x_i) \\ Z_i/L &= [(V/L)(K_{\text{ideal}}) + 1](x_i) \\ Z_i/[(V/L)(K_{\text{ideal}}) + 1] &= (L)(x_i) = L_i \\ L_i &= Z_i/[(V/L)(K_{\text{ideal}}) + 1] \end{aligned}$$

To solve the mass balance for the number of moles in the liquid and vapor phases:

- (1) Assume a V/L ratio (where V is total molar volume including the inert gases)
- (2) Calculate the liquid moles of each volatile component by:  

$$L_i = \frac{Z_i}{[(V/L)(K_{ideal}) + 1]}$$
- (3) Calculate the vapor moles of each volatile component by:  

$$V_i = Z_i - L_i$$
- (4) The moles of inert out of the condenser is equal to the moles into the condenser, which has been calculated previously.
- (5) Sum the volatile component liquid moles (L) and the volatile and inert component vapor moles (V) and compute the ratio V/L.
- (6) The computed V/L is compared to the assumed V/L. If they are not equal, a new iteration is performed using the calculated V/L.

The following table shows the values used for the iteration:

Iteration	Assumed V/L	Calculated		$Z_{N_2}$	Calculated V/L
		LA	VA		
1	0.50	0.131	0.00249	0.3106	2.43
2	2.43	0.122	0.0113	0.3106	2.68
3	2.68	0.121	0.0124	0.3106	2.71
4	2.71	0.121	0.0124	0.3106	2.71
5	2.72	0.121	0.0124	0.3106	2.72

The mass of each component is related to its moles by:

$$\begin{aligned}
 M_i(\text{lbs}) &= (V_i)(MW_i) \\
 M_A(\text{lbs/hr}) &= (0.0124)(58.08) \\
 &= 0.73 \text{ lb/hr}
 \end{aligned}$$

$$\begin{aligned}
 M_A(\text{lbs/day}) &= 0.73 \text{ lb/hr} * 24 \text{ hrs/day} \\
 &= 17.5 \text{ lb/day}
 \end{aligned}$$

$$\begin{aligned}
 M_A(\text{lbs/yr}) &= 17.5 \text{ lb/day} * 365 \text{ days/yr} * \text{ton}/2000 \text{ lb} \\
 &= 3.2 \text{ tons/yr}
 \end{aligned}$$

### FUGITIVE EMISSIONS:

(a) Gen'l Tank TK 7 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	16	0.00183	0.7027	0.000697	0.2676		
Pumps & Agitators	1	0.10891	2.6138	0.004969	0.1193		
Liquid Valves	7	0.015653	2.6297	0.001459	0.2451		
Vapor Valves	2	0.012346	0.5926	0.000309	0.0148		
Pressure Relief Valves	1	0.229281	5.5027	0.229281	5.5027		
TOTAL Fugitive Emissions			12.0416		6.1496	2.1976	1.1223

Methodology:

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Shadeland, Indiana  
Reviewer: Aida De Guzman

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Emissions, ton/yr = No. of components \* lb/hr/component \* 8760 hrs/yr \* ton/2000 lb

(b) Gen'l Tank TK 18 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	12	0.00183	0.5270	0.000697	0.2007		
Pumps & Agitators	1	0.10891	2.6138	0.004969	0.1193		
Liquid Valves	4	0.015653	1.5027	0.001459	0.1401		
Vapor Valves	1	0.012346	0.2963	0.000309	0.0074		
Pressure Relief Valves	1	0.229281	5.5027	0.229281	5.5027		
TOTAL Fugitive Emissions			10.4426		5.9702	1.9058	1.0896

(c) Gen'l Tank 20 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	150	0.00183	6.5880	0.000697	2.5092		
Pumps & Agitators	1	0.10891	2.6138	0.004969	0.1193		
Liquid Valves	44	0.015653	16.5296	0.001459	1.5407		
Vapor Valves		0.012346		0.000309			
Pressure Relief Valves		0.229281		0.229281			
TOTAL Fugitive Emissions			25.7314		4.1692	4.6960	0.7609

(d) Gen'l Tank TK26 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	14	0.00183	0.6149	0.000697	0.2342		
Pumps & Agitators		0.10891					
Liquid Valves		0.015653					
Vapor Valves		0.012346					
Pressure Relief Valves		0.229281					
TOTAL Fugitive Emissions			0.6149		0.2342	0.1122	0.0427

(e) Centrifuge HF-3 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	20	0.00183	0.8784	0.000697	0.3346		
Pumps & Agitators		0.10891		0.004969			
Liquid Valves	3	0.015653	1.1270	0.001459	0.1050		
Vapor Valves		0.012346		0.000309			
Pressure Relief Valves		0.229281		0.229281			
TOTAL Fugitive Emissions			2.0054		0.4396	0.3660	0.0802

(f) Mother Liquor Receiver Tank TK-HF3 Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	86	0.00183	3.7771	0.000697	1.4386		
Pumps & Agitators	1	0.10891	2.6138	0.004969	0.1193		
Liquid Valves	43	0.015653	16.1539	0.001459	1.5057		
Vapor Valves		0.012346		0.000309			
Pressure Relief Valves		0.229281		0.229281			
TOTAL Fugitive Emissions			22.5448		3.0636	4.1144	0.5591

(g) Miscellaneous Piping Fugitive Emissions:

FUGITIVE EMISSION COMPONENTS	POTENTIAL UNCONTROLLED FUGITIVE EMISSIONS						
	QUANTITY	Uncontrolled Emissions		Controlled Emissions		EMISSIONS	
						Uncontrolled (tons/yr)	Controlled (tons/yr)
		SOCMI FACTORS lb/hr/component	Daily Emission (lb/day)	LDAR Factors (lb/hr component)	Daily Emissions		
Flanges	220	0.00183	9.6624	0.000697	3.6802		
Pumps & Agitators		0.10891		0.004969			
Liquid Valves	13	0.015653	4.8837	0.001459	0.4552		
Vapor Valves		0.012346		0.000309			
Pressure Relief Valves		0.229281		0.229281			
TOTAL Fugitive Emissions			14.5461		4.1354	2.6547	0.7547

SUMMARY OF EMISSIONS (TONS/YEAR)															
Equipment ID	Capacity (gallons)	Potential To Emit Uncontrolled					Potential To Emit Controlled					PSD Emissions			
		VOC & Org. HAPs	CO	SO2	NOx	Inorganic HAPs	VOC & Org. HAPs	CO	SO2	NOx	Inorganic HAPs	VOC & Org. HAPs	CO	SO2	NOx
Gen'l Tank TK 20	4,000	62.27	79.09	-	6.78	48.00	6.62	79.09	-	6.78	48.0	6.62	79.08		6.78
	Fugitive	4.70					4.70					4.70			
Gen'l Tank TK 26	4,000	62.27	79.09	121.20	6.78	48.00	6.62	79.09	121.20	6.78	48.0				
	Fugitive	0.11					0.11								
Gen=I Tank TK 7	2,000	38.03	39.55	60.60	3.39	24.00	3.90 2.20	39.55	60.60	3.39	24.0				
	Fugitive	2.20													
Gen=I Tank TK 18	500	10.29	9.89	15.15	0.85	6.00	1.07	9.89	15.15	0.85	6.0				
	Fugitive	1.91					1.91								
Centrifuge HF-3	N/A	33.94				24.00	3.20				24.0	3.20			
	Fugitive	0.37					0.37					0.37			
Mother Liquor Receiver Tank TK HF-3	100	6.65				1.19	0.83				1.19	0.83			
	Fugitive	4.11					4.11					4.11			
Miscellaneous Piping Modification	Fugitive	2.65					2.65					2.65			
TOTAL		229.49	207.62	196.95	17.80	151.19	38.33	207.62	196.95	17.80	151.19	22.53	79.09	0.00	6.78